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CONTENTS

Vol. 18 July - December, 2023 No. 2

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INDUCTION SPAWNING OF ENDANGERED LABEO CALBASU (HAMILTON, 1822) UNDER HATCHERY SYSTEM

B. K. Chakraborty
Executive Director, Mud eel, Mud Crab, Aquaculture and management Centre &
Supervisor, Bangladesh Agricultural University &
Former Project Director/Director, Department of Fisheries, Dhaka, Bangladesh
Corresponding autho: bborty@gmail.com

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ABSTRACT

Efficacy of two inducing hormones (PG and Ovaprim) was conducted on induced breeding of endangered Kalibaus (*Labeo calbasu*). Induced breeding of *Labeo calbasu* was carried out from April to July, 2022. Male and female brood fish weighing between 1.2 kg to 2.0 kg in case of male and 1.4 to 2.5kg in case of female were selected for the induced breeding and sex ratio were maintained 1:1 for the breeding purpose. The experiment was designed with the month of April, May, June and July with PG and LHRH-A. Two hormonal sources were tested to evaluate their efficacy on ovulation, fertility and hatching rate of pangas under controlled conditions. Double doses of PG (an initial dose of 2.0 mg/kg body weight and final dose of 4.0-4.5mg/kg body weight) and single dose of Ovuline® (LHRH-A) (0.44 -0.50ml/kg body weight) and showed better result in case of female. Bothe PG and LHRH-A had showed better results of ovulation, fertility and hatching rate of *L. calbasu* in the month of May-June. Males were administered with a single dose of Ovuline® (LHRH-A) 0.15 ml/kg body weight and PG 2 mg/kg body weight showed better result of spermiation. Highest GSI value (22.82%) and fecundity (5013019.96) were found in 1.550.86 kg body weighted fish and the lowest value of GSI (18.24%) and fecundity (3505618.76) were found in 1.510.96kg body weighted fish. The highest fertilization rates (98.401.17%), hatching rates (88.032.76%) were recorded in treatment of PG and highest fertilization rates (98.640.84%), hatching rates (89.55^{a} 0.88%) were recorded in treatment of LHRH-A. This experiment recommends Ovaprim and PG both are efficient for inducing ovulation, fertilization and hatching of *L. calbasu*. The hatchery operators may be used both PG and LHRH-A for induction of spawning better performance of *L. calbasu* breeding.

Keywords : *PG, LHRH-A, ovulation, fertilization, hatchling, efficacy.*

INTRODUCTION

Labeo calbasu is vernacularly known as Calbasu/Kurcha/Mahlee/Kalabeinse in India; Kalibaus/Kalbasu in Bangladesh; Nga-nek-pya/Nga-noo-than/ Nga-ong-tong/Nga-gyeen-boo in Myanmar (Chondar 1999). *L. calbasu* is the most important carp species next to the three Indian major carps i.e. *Labeo rohita, Catla catla* and *Cirrhinus mrigala* (Chondar, 1999). It is a freshwater fish species belonging to the family Cyprinidae under the order Cypriniformes. It is a popular food fish having good taste, less intramuscular bones and high

protein content; is also admired as a good sport fish (Talwar and Jhingran, 1991, Rahman, 2005). This fish species supports an important commercial fishery in rivers and reservoirs of different countries mainly in Indian sub-continent (Pathak and Jhingran, 1977, Chondar, 1999, Dwivedi et al., 2004, Nautiyal et al., 2004). Recently the entry of the fish as an ornamental fish markets of India (Gupta et al., 2012) and also has been reported to be exported as indigenous ornamental fish (Gupta and Banerjee, 2014). The natural populations of this fish species has seriously declined due to overfishing, habitat degradation, aquatic pollution, dam construction and several other anthropological reasons which are affecting its feeding migration and spawning (CAMP, 1998, Hossain et al., 2010; Hasan et al., 2013; Chakraborty and Momi, 2022). In Bangladesh, it has been documented as endangered species according to the red list of IUCN Bangladesh, 2000.

Aquaculture contributes national income, employment generation. Artificially produced fish seed at hatchery plays a role on socio economic development and food security of the Bangladesh (Hossen et al., 2020; Kubra et al., 2020). Artificially produced fish seed at hatchery is supported the carp's culture of the country (Debnath et al., 2020; Sabj et al., 2015). Many hormonal treatments such as carp pituitary extract (PG), human chorionic gonadotropin (HCG) or different luteinizing hormones have been used to induce spawning in different fish species.

Availability of *Labeo calbasu* (Hamilton, 1822) in indigenous waters, culture suitability with other carp species, great market demand and high nutritional quality makes it good table fish (Halder et al., 2020;Ali et al., 2014). Akhtar and Bhuiyan (2012) observed the effect of two inducing agents, PG and DOM+SGnRH on the induced breading of. *L. calbasu.* The effect of ovaprim on the induced breeding of *L. calbasu* is not yet observed. Besides, most of the hatchery operator of our country has no clear knowledge about effective hormone and its optimum dose. Considering the above facts, the present investigation was done to study effective dose of Pituitary gland extract and ovaprim hormone on the breeding performance of *L. calbasu.*

About 5.36g oil is found form 65 cm of *L. calbasu* liver. Its liver oil contains Vitamin "A" (Ghosh *et.Al*. 1933). This fish is in great demand in the market. The aim of the study is to find out the technique of artificial propagation, early life cycle from oocyte, activation to the beginning of the fry under hatchery conditions.

MATERIALS AND METHODS

The experiment was conducted in the Al-Amin hatchery, Sibpur, Gouripur, Mymensingh. The induced breeding experiments were conducted during April to July 2021. The mature male and female brood fishes were caught from the rearing pond with a seine net and they were placed in the separate breeding tank. The ripe fish were selected based on physical and visual examination of the pectoral fin, abdomen and genital opening (Jhingran and Pullin, 1985). Matured brood stocks of *L. calbasu* were selected based on their maturity condition. Males oozing milt on slight pressing of abdomen was selected and female with distinct budging of abdomen with a pinkish colour with egg. Intramuscular injection was done below the dorsal fin. Twenty four female fishes divided into eight groups were injected with PG extract (Fig. 1.a) and Ovuline® (LHRH-A) (Fig.1.b) placed in separate spawning tanks in different times.

The doses of PG extract in female at 1.0 to 2.0 mg/kg body weights was required for first injection. At the time of 2nd injection male fishes were injected with PG extract at 2.0 mg/kg body

weight and female fishes were injected with PG extract at 4.0-05 mg/kg body weight. Again Hormone Ovuline® (LHRH-A) at dose 0.3-0.4 ml/kg of female spawner and 0.15 ml/kg male was administered to the selected brood. Three male and three female fishes were released in the separate tank. Breeding behavioral changes and spawning activities were observed upto ovulation time.

Fig.1a : PG abstract **Fig.1b : Ovuline® (LHRH-A)**

Eggs were fertilized by dry stripping method. Female fishes were stripped to collect eggs in an enamel tray or plastic bowl. Milt from the male fish was collected by applying slight pressure on male's abdomen. The eggs and milt were mixed thoroughly in the plastic bowl with a soft and clean feather. A few drops of water were added in the bowl and was stirred continuously for 5-6 mins. The eggs were washed several times with freshwater and swollen eggs were transferred to different hatching jars under continuous water circulating system. The flow of water (600-800 ml/min) in the jar was regulated during the incubation period. The eggs hatched out within 22 to 25 hrs at temperature range of 26 to 31°C. After 22 to 25 hrs of fertilization, hatchlings were started to come out from the egg shell and hatching was completed within 2.0 to 4.0 hrs. Unfertilized eggs and egg-shells were cleaned from the hatchling jar within an hour of hatching to protect larvae from fungal infection.

The fertilization rate and hatching rate were calculated by the following formula:

$$\text{Fertilization rate} = \frac{\text{Number of fertilized eggs}}{\text{Number of total eggs}} \times 100 \text{ (Okomoda et al., 2017)}$$

$$\text{Hatching rate} = \frac{\text{Number of hatchlings}}{\text{Number of fertilized eggs}} \times 100$$

An early developmental stage of *L. calbasu* was observed upto 68.0 to 72.0 hrs starting from egg fertilization. The eggs collected randomly from the hatching jar.

Boiled chicken egg yolk mixed with water and sieved through a glass nylon cloth. After hatching, the fine egg yolk emulsion was then spreaded in water to feed the hatchlings. Larvae from different pair of parents were collected from hatching jars and released in the previously prepared different nursery ponds. The water temperature was recorded during experimental period.

Statistical analysis

The data were analyzed by one way ANOVA using MSTAT Software (Version) followed by Duncan's Multiple Range Test to find out whether any significant difference existed among treatment means (Zar 1984).

RESULTS AND DISCUSSION

Gonadosomatic Index (GSI) and Fecundity: Estimation of gonadal maturity and spawning season of any species is possible by using Gonadosomatic index of that species. The GSI value of *L. calbasu* in this study was varied from 18.24 to 22.82% and the obtained fecundity were varied from 3505618.76 to 5013019.96 (Table 1). Highest GSI value (22.82%) and fecundity (3505618.76) were found in 1.550.86 kg body weighted fish and the lowest value of GSI (18.24%) and fecundity (3505618.76) were found in 1.510.96kg body weighted fish. Mean ovarian weight of *L. calbasu* was observed around 20.07% of the body weight. Mishra and Saksena (2012) found that the ovarian weight was almost 20% of the body weight of full mature fishes.

Table 1: Gonadosomatic index and fecundity of Kalibaus (*L. calbasu)*

Body wt. (kg)	Gonad wt. (g)	GSI (%)	Fecundity
1.52±0.80	310.23±1.80	19.76	400411±8.06
1.53±0.86	345.43±1.66	21.57	441544±9.09
1.51±0.96	277.08±2.06	18.24	350822±10.01
1.50±0.88	288.10±1.26	19.34	350561±8.76
1.55±0.86	355.48±1.33	22.82	501301±9.96
1.54±0.78	329.39±1.26	21.71	484110±10.146

In this experience, it was found that *L. calbasu* was bred in the month of April to July 2023 where May and June was the peak. Commencement of breeding season for *L. calbasu* as observed in the present investigation agrees with the report of Sah et al., 2018 from Nepal. Breeding of *L. calbasu* was performed at an ambient water temperature of 26.0 to 28.8°C. This range of temperature is suitable for breeding of most indigenous small fishes (Islam and Chowdhury, 1976). *L. calbasu* seemed to have similar temperature requirement of Indian major carps. Male and female brood fish weighing between 1.2 kg to 2.0 kg in case of male and 1.4 to 2.5kg in case of female respectively, in good condition were selected for the induced breeding carried out during April to July 2023.

Pertinent data regarding the time of injection and ovulation, fertilization rate, time of hatching, hatching rate and temperature are furnished in Table 2. In the present experiment, injection of pituitary extract of 2.0mg/kg body weight at first and of 3.0-5.0mg/kg body weight of second injection of the *L. calbasu* showed better ovulation, fertility and hatchability success (Nandeesha et al., 1990). In case of male, the amount of PG required to promote spermatogenesis found to be 1.5-2.5 mg/kg of body weight administered at the time of application of second injection to the females. Best spawning occurred in the month of mid-May to mid-June under dual hormonal regime at the PG dose of 2.0 and 4.0mg/kg body weight in the case of female.

In the month of early April and July, administration of PG extract in female at a dose of 2.5 and 5.0mg/kg body weight showed lower fertilization and hatching rate. Ovulation occurred after 6-8 hrs of 2nd injection and hatchings occurred after 16 to 18 hrs of fertilization. Under the same PG doses highest fertilization and hatching rates were found to be 98.400.88% and 88.031.44%, respectively with significance differences with other doses. Thus the doses of PG have been optimized to 2.0 mg and 4.0-5.0 mg/kg body weight at first and second injection, respectively, for female of *L. calbasu* at an interval of 6 hrs, which was more or less similar to breeding of *Labeo rohita* and *Cirrhinus cirrhosus* (Menon *et al.*, 1971), *Cirrhinus reba* (Hossain, 2001) and *Puntius sarana* (Chakraborty et al., 2007).

The all fishes of *Labeo rohita* were ovulated administered with Ovaprim-C (Naeem *et al*., 2013). The result is in agreement with the work of Yeasmin *et al.,* (2013) where all female brood fishes injected with ovaprim and the fishes were successfully spawned. The result of the current work was similar with the result found by Jamroz *et al.* (2008) when ovaprim-c was used for *L. calbasu.* Naeem *et al.* (2005) conducted an experiment on induced breeding of Silver carp (*Hypophthalmichthys molitrix*), where all the 30 female fishes were

injected with Ovaprim-c at the rate of 0.6 ml/kg body weight and 100% ovulation were found.

Ovulin (LHRH-A) was found to be very effective agent for induced spawning of *L. calbasu.* In the month of May, best spawning occurred at the dose of 0.45ml/kg body weight in case of female and 0.15mlOvaprim/kg bodyweight in case of male injected at the same time. In the month of April and July, with increase in the amount of hormone i.e. a dose of 0.50ml/kg body weight showed good fertilization and hatching rate. Ovulation occurred after 6.0-8.0 hrs of hormonal injection and hatchlings came out after 18 to 24 hrs of fertilization. In June better spawning occurred at the dose of 0.46ml/kg body weight in case of female and 0.15ml Ovulin (LHRH-A)/kg body weight in case of male injected at the same time. Best fertilization and hatching rates were found to be at 98.640.96% and 89.550.88%, respectively in the month of 3rd week of May to second week of June.

Table - 2 : Effect of different doses of hormone on the spawning of *Labeo calbasu.*

Hormon	Months	Body weight		Doses of 1st injection (ml/kg or mg/kg)		Doses of 2nd injection ((ml/kg or mg/kg)		Ovulation period (hr)	Fertilization rate (%)	Hatching period (hr.)	Hatching rate (%)	Incubation temperature (°C)
		Male	Female (g)	Male	Female	Male	Female					
PG (Double dose)	April	1.55 ±1.23	2.20 ±1.82	-	2.5	2.0	4.5	6-8	80.02^{c} ±3.02	18.0-24.0	70.22^{c} ±3.86	26.2-28.8
	May	1.60 ±1.50	2.08 ±1.64	-	2.0	2.0	4.0	5-6	98.40^{a} ±1.17	18.0 - 22.0	88.03^{a} ±2.76	
	June	1.66 ±1.34	2.02 ±1.80	-	2.0	2.5	4.0	5-6	98.04^{a} ±1.02	18.0-22.0	87.10^{a} ±2.33	
	July	1.64 ±1.25	2.30 ±1.72	-	2.4	2.5	4.4	6-7	88.11^{b} ±1.82	18.0-24.0	75.11^{b} ±3.33	
Ovuline® (LHRH-A)	April	1.50 ±1.22	2.16 ±1.32	-	-	0.15	0.50	6-9	81.10^{d} ±2.02	18.0-24.0	72.03^{d} ±1.06	26.2-28.8
	May	1.62 ±1.40	2.28 ±1.88		-	0.12	0.45	6-7	98.64^{a} ±0.84	18.0-21.0	89.55^{a} ±0.88	
	June	1.63 ±1.44	2.22 ±1.72	-	-	0.12	0.44	6-7	97.88^{b} ±1.02	18.0-22.0	86.01^{b} ±1.68	
	July	1.68 ±1.55	2.40 ±1.82	-	-	0.15	0.50	6-9	87.83^{c} ±1.82	18.0-24.0	78.01^{c} ±2.08	

Figures with different superscripts in the same column varied significantly ($P < 0.01$).

Ovulin (LHRH-A) at 0.50 ml/kg body weight gave rise to complete ovulation in the stipulated time (13-14hr) which was very much similar to carp breeding (Nandeesa *et. al.*, 1990). The effective doses of Ovulin (LHRH-A) for induction of spawning have been optimized to 0.50-0.60 ml/kg body weight at

single doses of injection for female of *Labeo calbasu*, which was more or less similar to breeding of *Catla catla*, *Labeo rohita* and *Cirrhinus cirrhosus* (0.40-0.50 ml, 0.30-0.40 ml and 0.25-0.30 ml/kg body weight), respectively (Peter *et al*., 1988). A slightly increased amount of Ovulin (LHRH-A) as required in case of *Labeo calbasu* seemed to be related with the species specificity phenomenon.

Comparatively better fertilization and hatching rates (98.640.84and 89.550.88%) were found in fishes injected with ovaprim. The fertilization rate and hatching rate of ovaprim treated fishes were not significantly (P>0.05) different than PG treated fish (98.401.17and 88.032.76% respectively with (2.0 mgPG/kg 1st dose and 4.0mgPG/kg 2nd dose). Yeasmin *et al.* (2008) found that the rate of fertilization and hatching percentage are partially higher with Ovaprim at 0.45 ml/kg dose but the rates were decreased in 0.5ml/kg dose in induced breeding of common carp. Indira *et al.* (2013) observed better ovulation, fertilization and hatching rates in the Indian major carp which were treated with Ovaprim than PG. Nandeesha *et al*. (1990) recommended Ovaprim than PG hormone in the breeding of carps considering economically viability, farmer uses and ovulation, fertilization rate and hatching rate of carp fishes.

Labeo calbasu is a seasonal breeder; breeds in monsoon months (Qasim and Qayyum, 1961, Bhuiyan, 1964, Natarajan, 1971, Rao and Rao, 1972). The breeding season used to vary in different regions coinciding with the monsoon floods of those regions. Khan (1934) has reported July and August as spawning months for *L. calbasu* in Punjab waters. Bhuiyan et al. (2013) have reported April-August as its breeding season while Kabir and Quddus (2013) have documented peak spawning in July in Bangladesh Khan and Mukhapadhyay (1975) noted that the success of induced breeding depends largely on proper selection of brood fishes, which has proved very true in the present experiment. Accomplishment of successful spawning depends on selection of suitable recipient fish at the proper stage of ovarian development and creation of congenial spawning conditions (Nash and Shehadesh, 1980) which is very accurate in the present experiment. The egg capsule and yolk sphere are yellowish brown in color. The ovulated eggs of *L. calbasu* further increased around 0.2 mm in size after incubation of fertilized eggs in hatchery, which might be due to hydration of the eggs. The fertilized eggs were found in clutch among the eggs during egg incubation in the hatchery. The egg membrane got separated giving birth to the uniform perivitelline space. The yolk sphere pushed towards the vegetable pole as the embryonic development proceeded. This could be due to providing more space for the divisional activities of blastomeres at the animal pole. The clarity of blastomeres as in 2-4 cell stage was gradually reduced as the cleavage proceeded for 64 cell stage onwards. The identity of blastomeres was completely lost at morula and blastula stage. After hatching 71-72hrs, yolk sacs were totally absorbed and the hatchlings were found to perform horizontal movement with sign of commencement of first feeding. Chicken egg yolk emulsion was fed for 200,000 hatchlings/one egg/day to meet up the dietary requirement. The purpose of this was to start the alimentary canal functioning before transferring them in the nurseries (Price, 1989). The water temperature was the main key factor for ovulation and hatchling. Temperature was recorded 26.2-28.50C during experimental period.

CONCLUSION

The findings of the present study that both PG extract and Ovulin (LHRH-A) are equally effective in induction of spawning in *L. calbasu*

under controlled hatchery condition. The hatchery operators may use any of the two sources of reproductive hormones as per their choice. But considering the ease of hormone administration, cost and easy availability, both pituitary gland (PG) and Ovulin (LHRH-A) seems to be same advantageous for artificial propagation of *L. calbasu.*

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IMPACT OF CLIMATE CHANGE ON AGRICULTURE CROP PRODUCTION AND ISSUES, CHALLENGES IN AGRICULTURE

Arvind Kumar
Department of Agronomy
Shri Karan Narendra Agriculture University, Jobner, Jaipur - 303329, (Rajasthan)
Email: arvind1266@gmail.com

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ABSTRACT

Climate change and global warming, considered to be approximation of long term change in the statistical values the parameters deciding weather of a region, have seen drastic changes leading to one of the greatest challenges for the survival of humanity on earth. It has created an imbalance in almost every sector like agriculture, rise in sea level, melting in glaciers, etc. The credit to this largely goes to industrial revolution and emerging new technologies which are not eco- friendly. Among other sectors, agriculture is the most affected field. Developing countries whose economies largely depend on agriculture are supposed to bear the brunt of this threat. Whole earth is realizing the adverse impact posed by this new problem.

Agricultural greenhouse gas emissions contribute approximately 12% to total global anthropogenic GHG emissions. Cereals -rice, wheat, and maize are the largest source of human calories, and it is estimated that world cereal production must increase by 1.3% annually to 2025 to meet growing demand. The global warming potential (GWP) of CH_4 and N_2O emissions from rice, wheat, and maize, when expressed per ton of grain is similar, and that the lowest value for each cereal is achieved at near optimal yields. Results show that the global warming potential of CH_4 and N_2O emissions from rice 3757 kg CO_2 eq ha were higher than wheat 662 kg CO_2 eq ha and maize 1399 kg CO_2 eq ha. The yield-scaled GWP of rice was about four times higher 657 kgCO_2 eq Mg than wheat 166 kg CO_2 eq Mg and maize 185 kg CO_2 eq Mg Across cereals, the lowest yield-scaled GWP values were achieved at 92% of maximal yield and were about twice as high for rice 279 kg CO_2 eq Mg than wheat 102 kg CO_2 eq Mg or maize 140 kg CO_2 eq Mg, suggesting greater mitigation opportunities for rice systems. In rice-0.68%, wheat1.21% and maize1.06%, of N applied was emitted as N_2O respectively.

Agricultural production depends upon inputs of fertilizer, pesticides, insecticides, Irrigation water which could be minimized with computerized wireless sensor network to optimize the amount of fertilizer, pesticides, insecticides, Irrigation water by providing optimal level for each input. Similarly, there is urgent need to replace fertilizer, pesticides, and insecticides with bio-fertilizer, bio-pesticides, and bio-insecticides as well as by developing optimal pattern in cereal crops , fruit, vegetables, animal husbandry , fertilizer in soil in such a way that green house gases are minimized leading to minimal impact on climate change as well as global warming.

At present, there is considerable stress on sustainability with minimal global warming and climate changes, which could be achieved through proper balancing of agriculture including wheat, rice, vegetables and

animal husbandry, maximization of green energy in agriculture by introducing solar street light, solar light for reading purposes, solar pump for irrigation, solar heater and solar cooker, solar mobile charger, as well as other computer and communication appliances in such a manner that total contribution from agriculture is minimal to climate change and global warming and thus environmentally sustainable agriculture especially when both India and Pakistan have plenty of green energy – solar, bio-fuel, bio-energy, wind energy etc. The presentation is based on real scenario for sustainable agriculture leading to environmental friendly approach.

Keywords : *climate change, global warming, agriculture, crop cycle, green house gases, global warming potential*

INTRODUCTION

Agriculture is strongly influenced by weather and climate. While farmers areoften flexible in dealing with weather and year-to-year variability, there is nevertheless a high degree of adaptation to the local climate in the form of established infrastructure, local farming practice and individual experience. Climate change can therefore be expected to impact on agriculture, potentially threatening established aspects of farming systems but also providing opportunities for improvements. Most previous assessments of the impacts of climate change on agriculture (and indeed on other sectors) have focused on time horizons towards the end of the twenty-first century, illustrating theimpacts of anthropogenic climate change that could be avoided by reducing greenhouse gas emissions. However, there is also a need to assess the impacts of climate change over the next few decades, which may now be largely unavoidable owing to inertia in the physical climate system and the time scales over which large-scale change in human social, economic and political influences on greenhouse gas emissions could be brought about. Even if greenhouse gas emissions began to be reduced immediately, there would still be some level of ongoing warming for decades and some sea-level rise continuing for centuries, as the climate system is slow to respond fully to imposed changes. There is relatively little information in the literature available on climate change impacts over these time horizons, so we present MOHC climate projections for approximately 2020 and 2050 in order to put the existing literature into the context on these time scale Most of the simulation studies have shown a decrease in duration and yield of crops as temperature increased in different parts of India. Such reductions were, however, generally, offset by the increase in CO_2; the magnitude of these crops varied with crop, region and climate change scenario. In north India, irrigated wheat yields decreased as temperature increases, a 2°C increase resulted in 17%.

IMPACT OF CLIMATE CHANGE ON INDIAN AGRICULTURE :

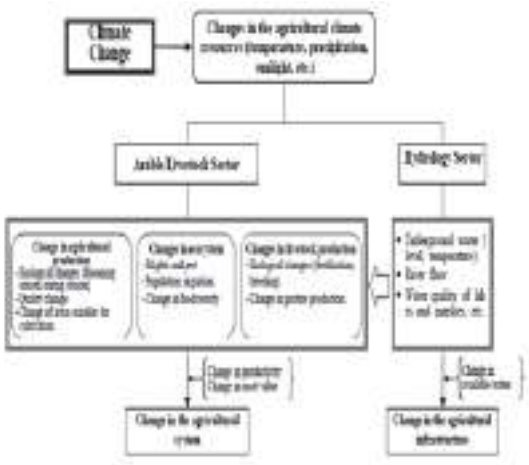
MATERIALS AND METHODS

➢ Impact of Climate Change on Agriculture

With changes in crops, as well as the need to shift some regions to new crops, and the associated skills training required.

Water Policy : Because impacts vary significantly according to whether crops are rain fed or irrigated, water policy will need to consider the implications for water demand of Agricultural change due to climate change.

Adaptive Measures : Policy-makers will also need to consider adaptive measures to cope with changing agricultural patterns. Measures may include the introduction of the use of alternative crops, changes to cropping patterns, and promotion of water conservation and irrigation techniques.



Decrease in grain yield but beyond that the decrease was very high. These decreases were compensated by increase in CO_2 due to letter's fertilizing effect on crop growth. CO_2 concentration ha to rise tp 450 ppm to nullify the negative effect of 1◦C increase in temperature. The effect of climate change scenario of different periods can be positive or negative depending upon the magnitude of change in CO_2 and temperature. He has also developed two scenarios based on IPCC (2001) as optimistic (low increase in temperature; high increase in CO_2) and pessimistic scenarios (high increase in temperature; low increase in CO_2) for different years. The possible impact of these studies showed that the irrigated wheat and rice yields in north India will not be significantly affected due to direct effect until 2050. It is only in 2070 when the temperature increases are very large, that the crops show large reduction in yield.

Positive and Negative Impact

Climate change affects the hydrology including underground water level, water temperature, river flow, and water quality of lakes and marshes, by impacting precipitation, evaporation, and soil moisture content. In particular, the increase of precipitation by climate change leads to an increase of outflow while the temperature rise increases evaporation, resulting in the reduction of outflow. In order to understand the quantitative impacts of climate change on water resources, a deterministic hydrology model, based on the general circulation model, is used Cloudiness and solar radiation under the climate changes scenarios were not taken into considerationin this analysis in view of the significant uncertainties associated with non-linear,abrupt and threshold rainfall events projected by GCMs over the Indian subcontinent. In this study, all the GCM projected climate change scenarios (at the time of doubling of CO_2 concentrations) predicted decreased yields for almost all locations. Mean decline in yields across different scenarios ranged from 14% in Pune (West India) to 23% in Gwalior (Central India). Decline in soybean yield is found to be less in west and south India as compared to other parts of the country. The mean yield was found to be significantly affected under UKMO model generated climate scenarios for both current and doubled CO_2 atmosphere.

ANIMAL IN A CHANGING CLIMATE: IMPACTS AND MITIGATION

Climate affects animal production in four ways: (a) the impact of changes in ethereal mammal feed-grain availableness and price; (b) impacts on ethereal mammal pastures and forage crop production and quality; (c) changes within the distribution of ethereal mammal diseases and pests; and(d) the direct effects of weather and extreme events on animal health, growth and reproduction. The indirect effects of climate driven

changes in animal performance result primarily from alterations among the nutritional surroundings. Analysis suggests that changes in climate would have an impression on the quality and quantity of forage created. The impact of climate change on pastures and rangelands would possibly embrace deterioration of pasture quality towards poorer quality subtropics C4 grasses in temperate regions as a results of hotter temperatures and fewer frost; however, there would possibly to boot exist potential can increase in yield and gettable enlargement of area if natural process were favourable as a results of increase in CO_2. As a consequence, productivity of grazing placental could be altered the present paper deals with the direct effects of natural process and may be primarily focused on the response Melcher. Completely different alternatives to chop back heat stress will be discussed. Physical modification and temperature change. In a very study developed in Australia, they have thought-about 2 essential THI thresholds, once:

Seventy two milk yield starts to say no for cows with no shade for cows with no shade represent three.3% of annual production. By the year 2030, milk loss for those self-same cows may increase to 4 wheel drive of annual production. By 2070, the milk loss would be 6 June 1944 of annual production. The authors additionally show the advantages of adapting by putting in shade and sprinklers. Milklosses underneath current climate are reduced to zero.8% of annual production, a 2.5% improvement on having no shelter. In 2030, adaptation may prohibit losses to a quarter of annual production. Finally, in 2070, milk losses would be reduced to three to 4 wheel drive of annual milk production, by putting in environmental modifications. According to (29) preliminary cost accounting indicates a money enjoy variations tocurrent climate, and shows that those edges can increase underneath temperature change. This meansthose current practices are going to be appropriate for adapting to future climates if theeconomics of warmth stress management don't amendment radically.

RESULTS AND DISCUSSION

Needs for further research

Due to the complex interaction of climate impacts, combined with varying irrigation techniques, regional factors, and differences in crops and the animal production rate, the detailed impacts of these factors need to be investigated further.

Specific recommendations for further research include :

- Precision in climate change prediction with higher resolution on spatial and temporal scales;
- Linking of predictions with agricultural production systems to suggest suitable options for sustaining agricultural production.Seventy eight milk yield starts to say no for cows with shade and a systemunder current climate, average milk lossesPreparation of a database on climate changeimpacts on agriculture;
- Evaluation of the impacts of climate change in selected locations; and
- Development of models for pest population dynamics

The current simulation results from GCM's are still considered uncertain. Present GCM's ability in predicting the impact of climate change on rainfall is still not promising. In addition, the uncertainty involved in predicting extreme flood and drought events by the models are large. There is, considerable uncertainties in the projected magnitude of change in temperature and rainfall for India. Climate change may have an effect on animal

production and well-being, especially thanks toincreases in air temperature. However, the data of animal responses to heat stress during the recent months in many areas of the world, also as during extreme heat events, could also be used to assess the impacts of worldwide amendment. Some current practices to reduce heat stress in dairy farm cows, like shades, sprinklers and ventilation will besuitable for adapting to future climates if the economics of heat stress management do notchange radically. However, farmer's don\'t seem to be quite aware about the impacts worldwarming can turn out in their operation. Therefore, good research work is required to help them take strategic and plan of action selections.

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IN-VITRO AND FIELD EFFICACY OF FUNGICIDES AGAINST SHEATH BLIGHT OF RICE (ORYZA SATIVA L.)

Deepak Mourya[1], Pankaj Singh[2], Rahul Yadav[3], Deepo Singh[4] and Atul Upadhyay[5]

[1,4,5]Department of Plant Protection, Aligarh Muslim University, Aligarh, (U.P.), India

[2]Department of Plant Pathology, Sardar Vallabhbhai Patel University of Ag. & Tech., Meerut, (U.P.), India

[3]Department of Seed Sceince and Technology, Chandra Shekhar Azad University of Ag. & Tech., Kanpur, (U.P.), India

Email: deepakmourya1096@gmail.com

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ABSTRACT

***Rhizoctonia solani* (teleomorph: *Thanatephorus cucumeris*) is a well-known pathogen that may infect a diverse variety of hosts and can be found all over the world. This pathogen is responsible for the Sheath Blight disease that affects rice. It is a very destructive disease in areas where rice is grown where the weather is good, which leads to large yield losses. During the kharif season of 2020-2021, tests were done on the rice variety Pant Dhan-4 at the Crop Research Station, Aligarh Muslim University, Aligarh (270 N latitude, 780 E longitude), Uttar Pradesh, to see how well different fungicides stopped sheath blight. A total of seven fungicides, namely Sheath Mark (validamycin 3% L), Tilt (propiconazole 25% EC), Beam (tricyclazole 75% WP), Folicur (tebuconazole 16%L), Contaf (hexaconazole 5% EC), Bavistin (carbendazim 50% WP), and Amistar (azoxystrobin 23% SC), were subjected to testing in order to assess their efficacy in inhibiting the growth of a specific pathogen at various stages of plant development. The control plots, on the other hand, were left untreated for comparative purposes. The application of Tilt (propiconazole 25% EC) (45.76%) resulted in a significantly lower disease severity (41.06%) compared to the control treatment, which exhibited a disease severity of 80.97%. Tilt also demonstrated a disease control efficacy of 41.37% over the control. Additionally, Tilt treatment led to the highest yield of 69.93q/ha, whereas the control treatment yielded 67.72q/ha. The use of Azoxystrobin 23% SC resulted in the lowest level of illness severity, measuring at 41.06%, and demonstrated a disease control rate of 46.03% compared to the control group.**

Among the fungicides that were examined. Azoxystrobin 23% SC was discovered to be the most effective and showed a hundred percent inhibition of the mycelial growth of R. solani at a concentration of 25 ppm when tested in vitro. According to the findings of this research, a new generation of fungicide known as Azoxystrobin 23% SC is more effective than previous formulations and can boost production by up to 22.42 percent.

Keywords : *Rice, sheath blight, disease, rhizoctonia solani, fungicides, rice.*

INTRODUCTION

Rice, scientifically known as *Oryza sativa* L., holds significant prominence as a cereal crop and a staple food grain within the global food grain supply. Rice is a grain crop, and it is one of the most important basic foods in Asia. Rice of the indica type

is grown in India. It is thought that an extra 114 million tons of ground rice are needed to meet the demand for rice around the world. So, in order to make this extra rice, output needs to go up by 2035, which means that it needs to go up by 26% over the next 25 years [1]. With the use of high-yielding varieties, fertilizers, irrigation, and intense farming methods, the number and severity of diseases that affect rice in several countries have gone up a lot [2].

Sheath Blight of rice, caused by the pathogen *Rhizoctonia solani* Kuhn, is a highly significant and extensively distributed disease in global rice cultivation regions. This disease poses a substantial threat to rice crops, leading to considerable yield losses and economic harm. The pathogen can attack plants from more than 32 families and 188 genera [4]. In recent years, the disease has become more important in most of the world's rice-growing areas. This is because more and more high-yielding varieties and blends that respond well to fertilizer are being grown. Under good conditions around the world, the blight can cut rice production by up to 50 percent every year [5]. When sheath blight becomes widespread and spreads to the plants' top leaves, it can cut yields by up to 20 percent [6–8].

Sheath rot has been blamed for up to 54.3% of rice crop losses in India, according to Chahal et al. (2003). The first report of the disease in India came from Gurdaspur, Punjab, by [9]. Concerns have arisen among farmers in prominent rice-producing states of India, including Andhra Pradesh, Karnataka, West Bengal, Assam, Uttar Pradesh, and Jammu and Kashmir. It is widely acknowledged that this phenomenon occurs in nearly all states engaged in rice cultivation, resulting in a significant decline in crop yields of up to 50%. The user did not provide any text to rewrite.

The disease is even scarier because current high-yielding varieties are grown in large amounts with lots of nitrogen fertilizer. A crop with a high plant density and a close cover is more likely to get sick as soon as the panicles start to form. The number of cases of the disease has gone up because of bad weed control and more frequent watering. Sheath rot is a disease that can be seen in both the nursery and the crop that has been moved.

Most of the time, the signs show up on the leaf sheath at water level in lowland ecosystems and at ground level in upland ecosystems. The pathogen makes greenish-grey spots that are elliptical, oval, or uneven on the leaf sheath and leaves. The edges of the spot are brown, while the middle is grayish white. When conditions are good, the virus quickly spreads to the upper leaf sheaths and leaf blades of the same or nearby tillers. Lesions on the plant's upper parts spread quickly and join up to cover the entire tiller from the water level to the flag leaf, killing the leaf, tiller, and plant in the end. When the intensity of sheath blight went up by 1%, the loss in grain yield was between 0.38 and 0.74 % [11, 12]. The genetic complexity of sheath blight resistance and the genetic variability of the pathogen make it harder to create resistant host genotypes and use tolerant cultivars successfully [13]. At the moment, we don't know of any rice types that are immune to sheath blight or have a high level of resistance to it. Fungicides are the major way to stop these diseases when there are no resistant donors that can be used. Fungicides like Zineb and others that were suggested in the past don't work well enough to keep diseases at bay. This study was done to find out how well different fungicides at different concentrations work to stop sheath blight in rice.

MATERIALS AND METHODS

Fungicides *in-vitro* effectiveness against *Rhizoctonia solani*

Rhizoctonia solani was obtained from the diseased sheath of the Oryza sativa plant. Subsequently, the obtained isolate was cultivated on a medium consisting of Potato Dextrose Agar

(PDA) under controlled conditions of temperature, namely 28 degrees Celsius with a tolerance of plus or minus 2 degrees Celsius, and a relative humidity of 70 percent. In this study, the effectiveness of seven fungicides, namely Sheath mark (validamycin 3% L), Tilt (propiconazole 25% EC), Beam (tricyclazole 75% WP), Folicur (tebuconazole 16% L), Contaf (hexaconazole 5% EC), Bavistin (carbendazim 50% WP), and Amistar (azoxystrobin 23% SC), was evaluated to determine their efficacy against R. solani. A range of concentrations, namely 5, 10, 15, 25, 50, and 100 ppm, for each fungicide was established based on its active component. The autoclaved PDA was subjected to an aseptic procedure, during which the appropriate amount of each fungicide was added. A total volume of 20 milliliters of molten medium, which had been modified with different amounts of the test fungicides, was dispensed into sterile petri plates with a diameter of 90 millimeters and left to solidify.

When determining the sensitivity of *Rhizoctonia solani* to different concentrations, we used three petriplates for each one. At the same time, appropriate controls that did not use fungicides were also maintained. Petri dishes containing PDA that had been contaminated with varying amounts of test fungicides were used to incubate mycelium agar discs with a diameter of five millimeters that had been cut from the periphery of an actively developing culture of R. solani that was three days old using a cork borer that had been sterilized. After being incubated for 72 hours at a temperature of 28 ± 2°C and a relative humidity of 70%, the inoculated petriplates were inspected. The diameter of the fungal colony was measured in each plate, and the percentage of inhibition in mycelial growth caused by each treatment relative to the control was computed. Following is the formula developed by [14] that was used to calculate the percentage of inhibition of mycelial growth, and the results were examined statistically using a design that was entirely randomized.

$$I = \frac{C \div T}{C} \times 100$$

Where, exactly I equals the percentage of growth inhibition in mycelia; C equals the average diameter of colony or fungal growth in the control group; and T equals the average diameter of colony or fungal growth in the treatment group.

Fungicides *in-vitro* effectiveness against *Rhizoctonia solani*

The field trials were carried out during the Kharif season of 2020-21 at the Crop Research Station, AMU, Aligarh. The trials followed a Randomized Block Design (RBD) with three replications. The plot size was 5.0 m X 2.0 m, with spacing of 15 cm X 20 cm. The primary aim of the studies was to evaluate the efficacy of several fungicides in managing sheath blight disease in the rice cultivar Pant Dhan- 4. The fungicides sheath mark (validamycin 3% L), Tilt (propiconazole 25% EC), Beam (tricyclazole 75% WP), Folicur (tebuconazole 16% L), Contaf (hexaconazole 5% EC), Bavistin (carbendazim 50% WP), and Amistar (azoxystrobin 23% SC) were applied on three separate occasions, with a 10 day interval between each application. The aforementioned application was submitted 60 days subsequent to the initial planting of the plant. The grain yield of each plot was quantified and recorded, denoted in quintals per hectare (q/ha).

Percent disease index

Using the Relative Lesion Height (RLH) method [15] and the following formula, the intensity of sheath blight was measured after each application of spray:

$$RLH = \frac{\text{Lesion height}}{\text{Plant height}} \times 100$$

In each plot, a total of five sampling units, each with an area of 1 m2, were randomly designated. The severity of the disease was assessed on a total of fifteen plants per sampling unit.

The percentage of illness control over the check was determined by employing the subsequent formula:

$$\text{Per cent}^{\text{over check}} = \frac{(\%)\text{ disease severity in check} \div (\%)\text{ disease severity in treatment}}{(\%)\text{ disease severity in check}} \times 100$$

The percentage increase in yield compared to the control group was determined using the following formula:

$$\text{Per cent}^{\text{over check}} = \frac{\text{Yield (q / ha) in treatment} \div \text{Yield (q / ha)in check}}{\text{Yield (q / ha)in treatment}} \times 100$$

RESULTS AND DISCUSSION

In-vitro evaluation fungicides against *Rhizoctonia solani*

The objective of this study was to assess the efficacy of seven fungicides, namely sheath mark (validamycin 3% L), Tilt (propiconazole 25 % EC), Beam (tricyclazole 75% WP), Folicur (tebuconazole 16%L), Contaf (hexaconazole 5% EC), Bavistin (carbendazim 50% WP), and Amistar (azoxystrobin 23% SC), in suppressing the growth of Rhizoctonia solani mycelia. The fungicides were produced at various concentrations and measured in

Table : 2 – Effects of Fungicides on Radial Growth and Growth Inhibition in the context of sheath blight of rice during the *Kharif* season of 2020-21.

S. No.	Fungicide	*Rhizoctonia solani*											
		Radial growth (mm)						Growth Inhibition (%)					
		5 ppm	10 Ppm	15 ppm	25 ppm	50 ppm	100 ppm	5 ppm	10 ppm	15 ppm	25 ppm	50 ppm	100 ppm
1	validamycin 3%	48.00	46.10	36.00	27.67	8.25	0.00	45.56	48.78	60.00	69.26	90.83	100.00
2	propiconazole 25% EC	18.08	9.75	6.08	0.00	0.00	0.00	78.80	89.16	93.25	100.00	100.00	100.00
3	tricyclazole 75 % WP	45.60	34.33	14.82	7.90	2.29	0.00	49.34	61.86	83.54	91.23	97.45	100.00
4	tebuconazole 16% L	51.70	35.60	28.48	8.93	2.70	0.00	42.56	60.45	68.36	90.07	97.00	100.00
5	hexaconazole 5% EC	33.10	29.17	14.35	1.77	0.00	0.00	63.22	67.59	84.06	98.04	100.00	100.00
6	carbendazim 50% WP	61.17	47.53	42.48	36.53	21.33	3.40	32.04	47.19	52.80	59.41	76.30	96.22
7	azoxystrobin 23% SC	18.50	12.35	11.75	0.00	0.00	0	79.44	86.27	86.94	100.00	100.00	100.00
8	Control	90	90	90	90	90	90	0.00	0	0	0	0	0
	A=Fungicide					**B=concentration**				**A*B**			
	CD at 5% =	1.09				0.94				2.26			
	SEm±	0.38				0.33				0.95			
	CV =	6.07											

parts per million (ppm), specifically 5, 10, 15, 25, 50, and 100. Following this, the subjects underwent testing utilizing the poisoned food methodology.

The findings presented in Table 1 demonstrate that Amistar and Tilt exhibited significant inhibitory effects (100%) on *Rhizoctonia solani* (Rice) at a concentration of 25 ppm. However, it is worth noting that Amistar displayed the highest level of inhibition (79.44%) at a concentration of 5 ppm. On the other hand, Contaf achieved complete inhibition at concentrations of 50 ppm and 100 ppm. This study exhibits similarities to the experiment conducted by [16] regarding the treatment of sheath blight of rice in an in vitro setting. The results of the experiment revealed that the utilization of azoxystrobin at concentrations of 10, 20, and 40 ppm led to complete suppression of mycelium growth in *Rhizoctonia soalni.*

***In vivo* evaluation of different fungicides**

A field trial was done during the kharif season of 2020-21to evaluate the efficacy of various fungicides. The results indicated that all tested fungicides exhibited a considerable reduction in disease severity and a notable improvement in grain production for the cultivar Pant Dhan-4, as shown in Table 2. The superiority of Amistar (azoxystrobin 23% SC) in terms of illness reduction and yield enhancement was proven, with Tilt (propiconazole 25% EC) placing second.

Table : 2 – Effects of Fungicides on disease parameters in the context of sheath blight of rice during the *Kharif* season of 2020-21.

S. No.	Fungicide	*Rhizoctonia solani*											
		Radial growth (mm)						Growth Inhibition (%)					
		5 ppm	10 Ppm	15 ppm	25 ppm	50 ppm	100 ppm	5 ppm	10 ppm	15 ppm	25 ppm	50 ppm	100 ppm
1	validamycin 3%	48.00	46.10	36.00	27.67	8.25	0.00	45.56	48.78	60.00	69.26	90.83	100.00
2	propiconazole 25% EC	18.08	9.75	6.08	0.00	0.00	0.00	78.80	89.16	93.25	100.00	100.00	100.00
3	tricyclazole 75 % WP	45.60	34.33	14.82	7.90	2.29	0.00	49.34	61.86	83.54	91.23	97.45	100.00
4	tebuconazole 16% L	51.70	35.60	28.48	8.93	2.70	0.00	42.56	60.45	68.36	90.07	97.00	100.00
5	hexaconazole 5% EC	33.10	29.17	14.35	1.77	0.00	0.00	63.22	67.59	84.06	98.04	100.00	100.00
6	carbendazim 50% WP	61.17	47.53	42.48	36.53	21.33	3.40	32.04	47.19	52.80	59.41	76.30	96.22
7	azoxystrobin 23% SC	18.50	12.35	11.75	0.00	0.00	0	79.44	86.27	86.94	100.00	100.00	100.00
8	Control	90	90	90	90	90	90	0.00	0	0	0	0	0
	A=Fungicide					**B=concentration**				**A*B**			
	CD at 5% =	1.09				0.94				2.26			
	SEm± =	0.38				0.33				0.95			
	CV =	6.07											

In the current investigation, the efficacy of Amistar (azoxystrobin 23%SC) against sheath blight of rice was observed to be significantly high. This treatment resulted in a substantial yield of 69.93 q/ha, which was 22.42% higher than the control group. Additionally, Tilt (propiconazole 25% EC) exhibited a favorable outcome, yielding 67.72 q/ha, representing a 19.89% increase compared to the control group. The present study provides evidence that Amistar (azoxystrobin 23% SC), a fungicide belonging to the new generation, exhibits greater efficacy in managing sheath blight in rice. This finding supports previous reports by [17-20], which indicated that the application of azoxystrobin at rates of 125, 250, and 500 g/ha effectively inhibits the progression of sheath blight and improves crop yield.

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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES ON GROWTH AND YIELD OF CHILLI (CAPSICUM ANNUM LINN) CV. PUSA JWALA

Naveen Chandra Singh, Vishwanath, Manoj Kumar Singh and Dharmendra Kumar Singh
Department of Horticulture
Kulbhaskar Ashram Post Graduate College, Prayagraj - 211002 (U.P), India

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ABSTRACT

In the present investigation entitled "Effect of integrated nutrient management practices on growth and yield of Chilli (*Capsicum annum* L.) cv. 'Pusa Jwala' was carried out during 2022-2023. Climatic and edaphic conditions prevailing during the crop period have been described at appropriate places. The experiment was conducted during 2022-2023 in the farm of Department of Horticulture, Kulbhaskar Ashram Post Graduate College, Prayagraj, Uttar Pradesh. It is situated in Southern part of Uttar Pradesh, between latitude of 25.45 North, longitude of 81.84^0 and an elevation of 98 meters (322 ft) and stands at the confluence of the, the Ganges and Yamuna. The experiment wasconducted during 2022-2023 in the farm of Department of Horticulture, Kulbhaskar Ashram Post Graduate College, Prayagraj, Uttar Pradesh. It is situated in Southern part of Uttar Pradesh, between latitude of 925.45 North, longitude of 81.84^0 and an elevation of 98 meters (322 ft) and stands at the confluence of the, the Ganges and Yamuna and the factor are Azotobactor - 5 Kg/ha,FYM- 25tn/ha,RDF-120:60:50 kg/ha and the treatment is 11 are T1-100% RDF (NPK) ,T2- 100%FYM, T3-75%NPK+25%FYM, T4-50%NPK+50%FYM, T5-25%NPK + 75% FYM , T6-100% FYM + Azotobactor, T7-75%NPK+ 25%FYM+ Azotobactor T8-50% NPK+50%FYM+Azotobactor,T9-25%NPK +75%FYM +Azotobactor, T10100% Azotobactor, T11- Control with 3 replications and the observation to be recorded are-. plant height(30.74,43.76,57.08,66.52cm),number of leaves(38.49,55.43,87.97,110.36) and number of branches per plant(9.49,9.41,17.29,20.24), were recorded at varying growth stages (30, 60, 90 and 120 DAT) of the crop. The observations of the days required to first harvesting after transplanting. the duration of flowering (154.59 days), fruits set per plant(98.13%), duration ofpicking(107.97days), number of fruit per plant(0.150kg), length of fruit(8.13cm), weight of fruit per plant(16.49kg), were recorded at harvesting. The fresh fruit yield (11737.77kg/ha) and profit per hectare (Rs.292425) was computed.The study revealed that higher value of the plant height, number of branches and number of leaves per plant were noted underT7 (T3 + Azotobactor). Whereas number of leaves show non-significance at 90 and 120 DAT. It was inferred that the higher values of the characters, viz duration of flowering , fruit set (%) and days taken to first harvesting after transplanting were noted underT7 (T3 + Azotobactor). While, late first harvesting were found with T11 (control). Duration of picking, number of fruit per plant, length of fruit, fruit weight per plant, fruit weight per plot and green chilli yield per hectare were recorded under T7 (T3 + Azotobactor). While fruit length found nonsignificance. Use of Azotobactor in combination with organic and inorganic fertilizers helped in additional increase of yields and

enhancing post-harvest quality parameters, indicating organic production could be practiced. The highest net returns and best cost-benefit ratio were recorded underT7 (T3+ Azotobactor).The poorest benefit cost ratio (1.56) was calculated under T2 (100% FYM).

Keywords : *Chilli, growth, yield.*

INTRODUCTION

Chilli (*Capsicum annum* L.) belongs to the family Solanaceae, grown for its fruit. It is one of the most important spice crops of the world and is widely cultivated throughout the warm, temperate, tropical and subtropical countries. Chilli was originated in tropical America and its seeds were brought to Spain in 1493 by Columbus which rapidly spread in Europe. It was introduced India by Portuguese during 16th century (Raju and Luckrose, 1991) and it isan indispensable spice essentially used in every Indian cuisine due to its pungency, spicy taste, appealing odour and flavour. Chilli fruits are rich source of Vitamin C, A and E.

Pusa Jwala variety has been developed by NP 46 A × Puri Red. Fruits are long, thin, and green in colour and usually curved at the tip. Fruits are long (above 10 cm), thin and pendent, contain low seeds and mildly pungent. Prone to viral diseases and root knot nematodes. Yield is 20-30 q/ha. Capsicin content of oleoresin is 8.0%. Adaptable to all over India. It is more suited for use as green chilli.

Major components of INM are organic manure, Bio-fertilizer & Chemical fertilizer. Organic manure not only balances the nutrient supply but also improves the physical & chemical properties of soil. In the present Indian Agriculture, keeping in view the inadequate availabilityof organic sources of nutrients & expected yield decline at least in the initial years, complete substitution of chemical fertilizer is not necessarily warranted, rather organic sources should be used as partial replacement of the chemical fertilizer.

MATERIALS AND METHODS

A Present experiment entitled, Effect of integrated nutrient management practices on growth and yield of Chilli (*Capsicum annum*) cv. 'Pusa Jwala' was conducted at research farm, Department of Horticulture, Kulbhaskar Ashram Post Graduate College , Prayagraj. In the present investigation FYM, NPK and Azotobactor were tried at different levels to study the effect of integrated nutrient management on growth and yield of chilli with eleven treatment combinations. The treatment combinations are T1-100% RDF (NPK) , T2- 100%FYM, T3-75% NPK +25% FYM, T4-50% NPK + 50% FYM, T5 25% NPK+ 75% FYM , T6-100% FYM + Azotobactor, T7-75% NPK + 25% FYM + Azotobactor T8-50% NPK+50% FYM+Azotobactor, T9-25% NPK+75% FYM+Azotobactor, T10-100% Azotobactor, T11- Control. Total eleven treatments consisted of fertilizers, organic manures and bio-fertilizers were tested in a randomized block design with three replications. Seedlings of chilli variety Pusa Jwala were sown in the Nursery on 04/09/2022. Seedlings were transplanted on well prepared field on 15/10/2022 with 45 x 30 cm spacing, inorganic and organic fertilizers were given manually. Farm Yard Manure, were applied on fifteen days before transplanting. The half amount of nitrogen (urea) with full dose of phosphorus (SSP) and potassium (Murate of Potash) were applied as basal dose at the time of transplanting. The remaining half dose of nitrogen were top dressed at 30 days after transplanting. Bio-

fertilizers – Azotobacter was applied in roots zone just prior to transplanting of the seedlings and thoroughly mixed in soil. Uniform inter-culture, weeding, hoeing, irrigation and plant protection measures were practiced in all the plots. Different observations on growth parameters, viz. plant height, number of leaves and number of branches per plant, were recorded at varying growth stages (30, 60, 90 and 120 DAT) of the crop. The observations of the days required to first harvesting after transplanting. the duration of flowering, fruits set per plant, duration of picking, number of fruit per plant, length of fruit,weight of fruit per plant, were recorded at harvesting. The fresh fruit yield and profit per hectare was computed.

RESULTS AND DISCUSSION

1. Effect on morphological character

Plant height (cm)

Data in respect of height of plant showed that the effect of integrated nutrient management i.e. reduced doses of fertilizers with bio -fertilizers and organic manure on plant height was significant at all the stages of plant growth. However, at all the successive stages of plant growth from 30 DAT to 120 DAT, treatmentT7 (T3+ Azotobactor) had produced (66.52cm) maximum plant height followed by treatment T8 (T4+ Azotobactor) andT9(T5+ Azotobactor) (65.52cm and 64.97cm) whereas minimum. plant height (14.81 cm, 27.83 cm, 41.14 cm and 54.29 cm at 30, 60, 90 and 120 DAT, respectively) was recorded with T11 (control) followed by T10 (100% Azotobactor),T2 (100% FYM) andT6 (T2+Azotobactor) Number of branches per plant.

The treatment differences regarding number of branches of plant were found to be significant. An application of inorganic fertilizers and bio-fertilizers with organic manure showed that the treatments were significantly influenced at all the plant growth stage in case of number of branches. Application of treatment (T7)75% NPK + 25% FYM along with Azotobactor resulted in significantly highest number of branches per plant at 30 and 60 DAT. However, this treatment was found on a par with treatment T8 (T4+ Azotobactor) at 60, 90 and 120 DAT. At all crop growth stages, in general significantly minimum number of branches per plant were noted under treatment T11 (control) followed by T10 (100% Azotobactor).

Number of Leaves Per Plant

Regarding the number of leaves, it has been observed that the effect of different treatments of integrated nutrient management was significant at all stages of plant growth except 90 and 120 DAT.

The treatment differences regarding the spread of plant were found to be significant at the plant growth stages from 30 DAT to 60 DAT besides 90 and 120 DAT. However, maximum numberof leaves (110.36) was observed in treatment T7(T3+ Azotobacter), during the stage of 120 DAT and it was closely followed by treatment T8(108.87) and T9(107.67). Whereas minimum number of leaves (94.49) associated with T11 (control)followed by T10(100% Azotobactor),T2 (100% FYM) andT6 (T2+Azotobactor).

PHENOLOGICAL CHARACTERS

Days taken to first flowering

Duration of flowering was found to be influenced statistically non-significant. The maximum duration of the flowering (154.59 days) were recorded under T7 (T3+ Azotobactor), followed by T8(T4+ Azotobactor),T9 (T5+ Azotobactor),T3(75% NPK + 25% FYM) and T4 (50% NPK+50%FYM) without level of significance margin. The minimum duration of flowering (140.09 days) were recorded under T11 (control), followed by T10 (100% Azotobactor),T2 (100% FYM) andT6 (T2+Azotobactor).

Fruit set (%)

Fruit set (%) were influenced significantly by different nutrient treatments. The maximum fruit set percentage (98.13%) were recorded under T7 (T3+ Azotobactor), which was at par with treatmentT8 (T4+ Azotobactor), T9(T5+ Azotobactor),T3 (75% NPK + 25% FYM),T4 (50% NPK+50%FYM) and T1 (100% RDF (NPK). The minimum fruit set percentage (82.91%) were recorded under T11 (control), followed by T10 (100% azotobactor),T2 (100% FYM) andT6 (T2+Azotobactor).

Days taken to first picking

Days taken to 1st harvesting after transplanting were found to be significantly influenced due to different treatments of integrated nutrient management. The maximum days to required days taken to 1st harvesting after transplanting(119.12 days) were recorded at T11 (control), followed by T10 (100% azotobactor),T2 (100% FYM) andT6 (T2+Azotobactor). The minimum days required to days taken to 1st harvesting after transplanting (107.55 days) was significantly recorded under T7 (T3+ Azotobactor), followed by T8 (T4+ Azotobactor), T9(T5+ Azotobactor) andT3 (75% NPK + 25% FYM).

EFFECT ON YIELD CONTRIBUTING CHARACTER

Duration of picking (Days)

Duration of picking was found to be influenced statistically significant. The maximum duration of the picking(107.97 days) were recorded under T7 (T3+ Azotobactor), followed by T8(T4+ Azotobactor),T9 (T5+ Azotobactor),T3(75% NPK + 25% FYM) and T4 (50% NPK+50%FYM) with level of significance margin. The minimum duration of picking (93.41 days) were recorded under T11 (control), followed by T10 (100% Azotobactor),T2 (100% FYM) andT6 (T2+Azotobactor).

Number of Fruits Per Plant

The treatment differences regarding number of fruits of plant were found to be significant. An application of inorganic fertilizers and bio-fertilizers with organic manure showed that the treatments were significantly influenced at 30, 60, 90 and 120 DAT in case of number of

fruits. The maximum number of fruits per plant (94.75) was found with T7 (T3+Azotobactor), which was at par with treatment T8 (T4+ Azotobactor), T9 (T5+ Azotobactor), T3 (75% NPK + 25% FYM), T4 (50% NPK + 50% FYM) and T5 (25% NPK+75%FYM). The minimum number of fruits (69.74) was recorded under T11 (control), followed by T10 (100% azotobactor),T2 (100% FYM) andT6 (T2+Azotobactor).

Length of fruits (cm.)

The length of fruit was non -significantly influenced by different treatments of integrated nutrient management. The maximum fruit length were (8.13 cm) and (7.20cm), respectively under the treatments T7 (T3+Azotobactor), T8 (T4+Azotobactor) andT9 (T5+ Azotobactor). The minimum fruit length (3.66 cm) were recorded under T11 (control), followed by T10(100% Azotobactor)T2 (100% FYM) andT6 (T2+Azotobactor).The fruit length was non-significantly influenced by fertilizer and organic manures.

Fruit Weight Per Plant (Kg)

Data in respect of weight of fruits per plant were found to be significantly influenced by different bio fertilizers, chemical fertilizers and organic manures. The maximum fresh weightof fruits per plant (0.150kg) were significantly recorded under T7 (T3+ Azotobactor),which was at par with treatmentT8 (T4+ Azotobactor), T9(T5+ Azotobactor) and 3 (75% NPK + 25% FYM). The minimum fresh weight of fruits were recorded

(0.112kg) under T11 (control), T10 (100% Azotobactor)T2 (100% FYM) andT6 (T2+Azotobactor).

Fruit Weight Per Plot (Kg)

Data in respect of weight of fruits per plot were found to be significantly influenced by different biofertilizers, chemical fertilizers and organic manures. The maximum fresh weight of fruits per plot (16.49kg) was significantly recorded under T7(T3+ Azotobactor),which was at par with treatmentT8 (T4+ Azotobactor).The minimum fresh weight of fruits were recorded (12.73 kg) under T11 (control), followed by T10 (100% Azotobactor)T2 (100% FYM) andT6 (T2+Azotobactor).

Green chilli yield per h.(Kg.)

The green chilli yield kg/ha was influenced significantly by different nutrient treatments.The highest yield of green chilli (11737.77kg/ha) were produced with an application of treatmentT7 (T3+ Azotobactor),which was at par with treatmentT8 (T4+ Azotobactor), T9(T5+Azotobactor),T3 (75% NPK + 25% FYM),T4 (50% NPK+50%FYM), T5 (25% NPK+75%FYM) andT1 (100% RDF (NPK).The minimum Yield of green chilli were receiving (8961.29 kg/ha.) under T11 (control),followed by T10 (100% Azotobactor)T2 (100% FYM) andT6 (T2+Azotobactor).

Economics of treatments

It is inferred from the economics data presented that expenditure on various inputs was maximum (Rs.94660) in T6 (T2+ Azotobactor) followed by T2(100% FYM). The minimum expenditure (Rs.76360) was incurred under T11 (control) followed by T10 (100% Azotobactor). The maximum gross income (Rs.293425), net return (Rs.205307) and cost benefit ratio (2.32) were calculated under T7 (T3+Azotobactor) followed by T8 (T4+ Azotobactor) While the minimum gross income (Rs.224025) and net returns (Rs.147675), were found T11 (control) treatment. The poorest benefit cost ratio (1.56) was calculated under T2 (100%NPK).

Table - 1 : Effect of INM practice on Phenological Characters of Chilli

Treatment	Number of leaves per plant				Days taken to first flowering	Fruit set(%)	Days taken to first picking	Duration of Picking
	30DAT	60DAT	90DAT	120DAT				
T1	**33.03**	**51.58**	**83.49**	**104.11**	**150.26**	**93.92**	**110.14**	103.82
T2	30.05	47.61	80.13	100.26	145.49	88.67	116.45	98.07
T3	34.14	52.63	84.88	106.65	150.85	94.51	109.47	105.16
T4	33.80	53.13	83.79	105.26	149.44	93.15	111.33	103.44
T5	32.46	50.45	82.66	103.74	148.17	91.29	113.91	101.54
T6	31.73	48.94	81.28	101.41	146.57	89.79	115.16	99.48
T7	38.49	55.43	87.97	110.36	154.59	98.13	107.55	107.97
T8	37.02	54.60	86.97	108.87	152.78	97.05	107.93	106.83
T9	36.55	53.30	86.20	107.67	151.18	96.69	108.44	105.81
10	29.66	46.05	78.92	98.93	142.61	86.32	117.49	96.50
T11	27.66	45.00	76.32	94.49	140.09	82.91	119.12	93.41
MSE	1.09	1.93	2.46	3.25	3.00	2.03	2.13	2.22
CD (5%)	3.24	5.71	NS	NS	NS	6.00	6.30	6.55

Table - 2 : Effect of INM practice on Morphological Characters of Chilli

Treatment	Plant height (cm)				Number of branches per plant			
	30DAT	60DAT	90DAT	120DAT	30DAT	60DAT	90DAT	120DAT
T1	26.76	39.78	53.09	63.13	5.56	6.35	13.36	15.86
T2	20.38	33.40	46.83	57.90	4.06	5.02	12.50	12.98
T3	27.31	40.33	53.64	63.92	6.40	7.70	14.41	17.19
T4	26.35	39.37	52.68	62.92	6.06	7.59	13.35	16.54
T5	24.17	37.19	50.50	61.80	5.58	6.48	13.11	15.75
T6	21.88	34.90	48.21	59.72	4.62	5.61	12.52	13.90
T7	30.74	43.76	57.08	66.52	8.50	10.42	16.30	21.25
T8	29.90	42.92	56.23	65.52	7.63	9.98	15.28	19.81
T9	28.95	41.97	55.29	64.97	6.66	8.61	14.94	18.87
T10	16.68	29.70	43.01	56.94	3.81	4.98	11.49	12.07
T11	14.81	27.83	41.14	54.29	2.20	4.22	8.72	9.67
MSE	0.083	1.26	1.53	1.83	0.27	0.31	0.53	0.56
CD (5%)	2.46	3.73	4.52	5.42	0.82	0.92	1.57	1.67

Table - 3 : Effect of INM practice on Yield of Chilli

Treatment	Number of fruit per plant	Length of fruit(cm)	Fruit weight per plant(kg)	Fruit weight per plot (kg)	Yield per ha. (kg)	B:C
T1	84.30	6.70	0.134	14.92	10577.45	2.10
T2	75.92	3.96	0.121	13.66	9647.64	1.56
T3	87.95	6.84	0.139	15.47	10982.60	2.14
T4	84.40	6.31	0.134	14.93	10588.18	1.95
T5	81.68	5.58	0.130	14.53	10287.00	1.80
T6	78.31	4.51	0.125	14.02	9912.19	1.61
T7	94.75	8.13	0.150	16.49	11737.77	2.32
T8	91.93	7.20	0.145	16.06	11424.01	2.16
T9	89.12	7.19	0.141	15.64	11112.84	2.00
T10	73.23	3.82	0.117	13.26	9349.05	2.02
T11	69.74	3.66	0.112	12.73	8961.29	1.93
MSE	3.52	1.08	0.0052	0.52	390.75	
CD (5%)	10.38	2.60	0.015	1.55	1152.75	

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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES ON GROWTH AND YIELD OF POTATO (*SOLENUM TUBROSUM* LINN) CV. KUFRI ASHOKA

Saurabh Patel, Dharmendra Kumar Singh, Manoj Kumar Singh and Vishwanath
Department of Horticulture
Kulbhaskar Ashram Post Graduate College, Prayagraj - 211002, (U.P.), India

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ABSTRACT

An experiment was conducted at Vegetable Research Form of Kulbhaskar Ashram PG College, Prayagraj.The sowing was done Nov. 27, 2022. Eight treatments consisting of different organic and inorganic fertilizer, both alone and in combination have been tried. Among the integrated nutrient management practices under different treatments T1 Control,T2 FYM @ 30 t/ha) + bio – fertilizer (PSB), T3 poultry manure@ 5 t/ha + bio – fertilizer (PSB),T4 Vermi – compost @ 5 t/ha + bio – fertilizer (PSB) ,T5 FYM @ 9 t/ha + poultry manure @ 1.7 t/ha + vermi – compost 1.8 t/ha + bio –fertilizer (PSB), T6 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB), T7 33% RDN through inorganic and 67% RDN through FYM+bio–fertilizer (PSB) and T8 100% bio-fertilizer (PSB). The T6 RDN (150 kg/ha) 67% RDN through inorganicand 33% RDN through FYM + bio–fertilizer (PSB) were significantly superior over the other treatments for all growth, yield and nutrient uptake of parameters and economics of production. T6 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) has resulted in higher plant height (48.15 cm), number of haulm and number of leaves (39.58 and 432.69, respectively), higher uptake of major nutrients viz., nitrogen, phosphorus and potassium (185.63, 35.84 and 186.50 kg ha-1 , respectively)in potato tuber. Yield studies characters viz., number of tuber (grade wise) hill-1, Weight of tuber (gm hill- 1), and tuber yield (kg plot-1) in 0-25g, 25-50g, 50-75g, and >75g (3.27, 2.25, 2.06, 2.05 and 24.16, 114.67, 137.94 and 185.87 and 2.51, 13.99, 18.00, 12.49) and yield of tuber (396.00 q ha-1) was found T6 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB).Apart from this the highest net income (Rs. 213755.00 ha-1) and benefit cost ratio (2.07:1) was realized with the 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB).The one year experiment, it is recommended that potato crop should be fertilized with 67% RDN through urea + 33% RDN through FYM to obtain the higher potato yield and benefit: cost ratio.

Keywords : *INM, potato, effect*

INTRODUCTION

Potato (Solanum tuberosum L.) is one of the most important basic vegetable and staple food-crops of the world as well as Indian continents which belong to family solanaceae. It originated from Peru and Bolivia in South America and introduced in India in early 17th centuries either by Portuguese or the Britishers which is grown throughout the country commercially from sea level to temperate region (upto 4000 msl). Potato is one of the value added and exportable items.

Potato is regarded as a short-duration crop

with an average cropping stand of 90-100 days along with higher yield potentially and nutritive value as compared to cereal crops so it has great potential to solve the food problem because it has capacity to produces very high yield 225 kg/day/ha as compared to rice and wheat i.e. 19 and 24 kg/day/ha in India, respectively (Anon., 2010a). In all, the potato is a highly nutritious, easily digestible, wholesome food which contains 77.5 % water and the rest is dry matter. Average dry matter composition is 16.5% starch, 0.9% sugar (0.6 total sugar and 0.3 reducing sugar), 4.0% protein (2.8crude and 1.6 true protein), 0.9% minerals, 0.59% fibre, 0.14% crude fat and considerable amount of vitamin A and C (Bose, 1993). Furthermore, the average biological value of potato protein (71% that of whole egg) is better than that of most other vegetables and comparable to that of cow's milk (75% that of whole egg). So it is a unique food, because it can be consumed as boiled or fried or processed, all with equal culinary delicacy. Perhaps no other food crop has such an inherent capacity as the potato to produce so many different processed products, which can be enjoyed across the generation gap.Potato is grown almost in all countries which is cultivated in 19.1 million ha with an annual production of 328.56 million metric tonnes, giving an average productivity 19.0 t/ha in world whereas, India rank is third in terms of area and second in production of potato in the world next to China. In India- area, production and productivity of potato is 1.86 million ha, 36.52 million metric tonnes and 19.8 t/ha respectively whereas, Uttar Pradesh is the largest producer followed by West Bengal. Share of potato in total vegetable production is 26.7%. But, when it is compared with data since last 9 years, area and production of potato are slightly increasing trends but the productivity is almost in static rate therefore productivity is lower as compared to other countries i.e. Netherland-45.6 and USA- 44.4 t/ha (Anon., 2010 b). In Uttar pradesh, potato is mainly cultivated in Farrukhabad, Manipuri,Etawh, Kannauj, Aligrah, and part of Kanpur districts which occupies 65316 ha area and produces 1,881,807 metric tonnes with an average yield 29.82 t/ha which occupies the first position in terms of productivity. However, trends of it is also almost in static rate (Anon., 2011).

Reasoning of this low productivity of potato is mainly attributed by poor quality of seed tuber; poor nutrient management practices and poor soil fertility; high incidence of insects and pest attack; lack of improved technologies especially in integrated nutrient management techniquesthrough organic farming and lack of promotion and dissemination of available improved technologies to the farmers.

MATERIALS AND METHODS

A field experiment entitled “Effect of integrated nutrient management on growth and yield of Potato (*Solanum tuberosum* Linn.) cv Kufri Ashoka'' was conducted at Research Farm, Department of Horticulture Kulbhasker ashram PG college prayagraj (up) during Rabi season 2022-2023. The experiment consisted 8 treatment combination T1 Control,T2 FYM @ 30 t/ha) + bio – fertilizer (PSB), T3 poultry manure @ 5 t/ha + bio – fertilizer (PSB),T4 Vermi – compost @ 5 t/ha + bio – fertilizer (PSB) ,T5 FYM @ 9 t/ha + poultry manure @ 1.7 t/ha + vermi – compost 1.8 t/ha + bio –fertilizer (PSB), T6 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB), T7 33% RDN through inorganic and 67% RDN through FYM + bio – fertilizer (PSB) and T8 100% Bio – fertilizer (PSB) All the treatment combinations were replicated three times.

The soil of the experiment field was Sandy loam in texture and medium in fertility status with the P H values 8.1, Organic corban 0.31%. The available nitrogen, phosphorus and potassium were

140.0, 15.2, and 240 kg ha-1 respectively. The silent findings of this study are summarized below: The quantity of nutrients through organic sources were supplied in three forms viz., farmyard manure, vermi- compost and poultry manure Bio-fertilizer at different levels on the basis of % nitrogen content. Inorganic major nutrients were supplied in the form of urea to supply N, respectively. Among the different treatments, 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) ha-1 had resulted in higher plant height, number of haulms and number of leaves at harvest. Highest number of 0-25 g, 25-50 g, 50-75 g and >75 g tubers (grade wise) hill-1 at harvest, respectively), highest weight of 0-25 g, 25-50 g, 50-75 g and >75 g tuber grade (g hill-1), highest weight of 0-25 , 25-50 g, 50-75 g and >75 g tuber grade (kg plot-1) and Tuber yield (q/ ha).

RESULT S AND DISCUSSION

1. Growth parameters:

It was observed that plant height was highest in the plots treated with T6 67% RDN through inorganic fertilizer and 33% RDN through FYM + bio – fertilizer PSB (46.10 cm) and (48.15 cm) at 60 and 90 days after planting, respectively followed by T7 33% RDN through inorganic fertilizer and 67% RDN through FYM + bio – fertilizer PSB (43.96 cm) and (46.07 cm) at 60 and 90 days after planting, respectively the least T1 control i.e.

The number of haulm m-1 and number of leaves m-1 were highly influenced by source of nutrients. The T6 recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic fertilizer and 33% RDN through FYM + bio – fertilizer (PSB) has recorded the highest number ofhaulms i.e., 37.36 and 39.58 at 60 and 90 days after planting, respectively followed by T7 recommended dose of nitrogen (150 kg/ha) 33% RDN through inorganic fertilizer and 67% RDN through FYM + bio – fertilizer (PSB) has recorded that number of haulms i.e., 35.83 and 37.68 the least T1 control i.e., 34.28 and 35.07. In the same way, T6 67% RDN through inorganic fertilizer and 33% RDN through FYM + bio – fertilizer (PSB) has recorded the highest number of leaves i.e., 448.77 and 432.69 At 60 to 90 days after planting respectively followed by T7 33% RDN through inorganic fertilizer and 67% RDN through FYM + bio – fertilizer (PSB) has recorded that number of leaves i.e., 435.36 and 414.30 the least T1 control i.e., 398.15 and 398.42. At 90 DAP the number of leaves plant-1 get reduced in all the treatments linearly due to high defoliation near to maturation. This increase in number of haulms and leaves might be due to increased uptake of nitrogen, phosphorus and potassium in these treatments. Naidu et al. (1999) also indicated the same trend in okra. Fresh weight and dry weight haulms were significantly influenced by sources of nutrients. In both the cases the plant treated with, T6 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) recorded highest values for fresh weight and dry weight of haulms i.e., 384.78 and 39.44 this might also be associated with increased in uptake of nitrogen, phosphorus and potassium because of application of farmyard manure along with recommended dose of fertilizer which resulted in better plant growth.

2. YIELD PARAMETERS

Undoubtedly adequate supply of nutrients in available form determines the number of tuber (grade wise) hill-1 and weight of tuber gram hill-1 . The T6 67% RDN through inorganic fertilizer and 33% RDN through FYM + bio – fertilizer (PSB) has recorded the highest number of tuber grade wise hill-1 (0- 25g, 25-50g, 50-75g and >75g) i.e., 3.27, 2.25, 2.06 and 2.05 respectively followed by T7 33% RDN through inorganic fertilizer and 67%

RDN through FYM + bio – fertilizer (PSB) i.e., 3.21, 2.18, 2.02 and 1.99 the least T1 control i.e., 3.05, 2.10, 1.91 and 1.90 T6 67% RDN through inorganic fertilizer and 33% RDN through FYM + bio – fertilizer (PSB) has recorded the highest number of tuber grade g hill-1 (0-25g, 25-50g, 50-75g and >75g) i.e., 24.16, 116.65, 137.94 and 185.87 respectively followed by T7 33% RDN through inorganic fertilizer and 67% RDN through FYM + bio – fertilizer (PSB) i.e., 20.46, 98.34, 115.93 and 156.61 the least T1 control 10.34,47.76,55.20 and 77.79. The highest grade wise number of tuber plot-1 was found in (10 t FYM ha-1 with 100% RDF NPK) reported by Raghav et al. (2008). Barman et al. (2018) observed that possibility of improving, growth and tuber yield of potato by the use of integrated nutrientmanagement. Results obtained after statistical analysis of data revealed that the height of plant, number of compound leaves/hill, number of haulms/hill,yield attributes and yield. Further number of A(0-25 g), B(25-50g), C(50-75g) and D(>75g) grade tubers/plot, percent of A(0-25g), B(25-50g), C(50-75g) and D grade tubers/plot, yield of A(0-25g), B(25-50g), C(50- 75g) and D(>75g) grade tubers/plot (kg), total number of tubers plot, total weight of tubers perplot (kg) and tuber yield (t/ha) showed the beneficial response by theuse of integrated levels of N, FYM and Vermicompost,bio-fertilizer. however, on the basis of pooled data it was also further observed that the application of 150 kg N, 9 t FYM and 5 ton Vermi-compost /ha of improvement in growth and tuber yield of potato. Organic nutrient sources are known to restore organic matter in soil and enhance nutrient use efficiency by a crop which results in improved growth, yield of a crop. In the present investigation, the potato crop has got higher T6 67% RDN through inorganic fertilizer and 33% RDN through FYM + bio – fertilizer (PSB) has recorded the highest number of tuber grade kg plot-1 (0-25g, 25- 50g, 50-75g and >75g) i.e., 2.51, 13.99, 18.00 and 12.49 respectively followed by T7 33% RDN through inorganic and 67% RDN through FYM + bio – fertilizer (PSB) i.e., 2.17, 11.69, 15.04 and 10.30 the

Table - 1 : Effect of INM practice on the Growth Parameters of Potato

Treatment	Emergence 30 DAP	Height of plant(cm)			Number of haulm m^{-1}		
		30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP
T1	91.35	17.56	40.21	43.27	8.59	34.28	35.07
T2	90.31	19.88	41.79	44.08	8.61	34.90	35.29
T3	92.91	20.60	42.12	44.61	8.62	34.93	35.34
T4	91.87	20.91	42.59	44.60	8.66	34.97	35.38
T5	92.39	21.21	43.55	44.79	8.68	35.88	36.29
T6	93.41	23.01	46.10	48.15	9.00	37.36	39.58
T7	90.31	21.31	43.96	46.07	8.77	35.83	37.68
T8	90.83	21.20	43.93	45.94	8.74	35.53	37.61
MSE	**0.71**	**0.93**	**0.88**	**0.49**	**0.08**	**0.48**	**0.60**
CD 5%	**NS**	**NS**	**1.88**	**1.47**	**0.25**	**1.45**	**1.81**

Table - 2 : Effect of INM practice on the Growth Parameters of Potato

Treatment	Number of leaves m-1			Fresh weight of haulm (g)m^{-1}	Dry weight of haulm (gm^{-1})
	30 DAS	60 DAS	90 DAS		
T1	68.23	398.15	398.42	357.46	35.07
T2	68.38	413.92	401.04	360.39	35.29
T3	68.47	417.21	401.59	362.29	35.34
T4	68.83	421.74	402.06	363.24	35.38
T5	69.44	430.85	412.80	367.60	36.30
T6	71.35	448.77	432.69	384.78	39.44
T7	70.35	433.36	414.30	372.74	37.21
T8	69.56	431.08	414.19	370.41	37.20
MSE	**0.83**	**4.76**	**5.47**	**3.83**	**0.52**
CD 5%	**2.50**	**14.43**	**16.58**	**11.60**	**1.57**

Table - 3 : Effect of INM practice on the Yield of Potato

Treatments	Number of tuber(grade wise) $hill^{-1}$				Weight of tubers (grade wise) g $hill^{-1}$			
	0-25g	25-50g	50-75g	>75g	0-25g	25-50g	50-75g	>75g
T1	3.05	2.10	1.91	1.90	10.34	47.76	55.20	77.79
T2	3.11	2.12	1.96	1.93	16.76	79.73	93.53	126.89
T3	3.12	2.13	1.97	1.97	17.36	82.80	97.29	131.80
T4	3.12	2.13	1.98	1.97	18.54	88.75	104.43	141.31
T5	3.12	2.16	1.99	1.98	18.91	90.57	106.59	144.25
T6	3.27	2.25	2.06	2.05	24.16	116.65	137.94	185.87
T7	3.21	2.18	2.02	1.99	20.46	98.34	115.93	156.61
T8	3.13	2.17	2.00	1.99	19.48	93.43	110.08	148.82
MSE	0.01	0.01	0.01	0.01	0.53	2.68	3.22	4.57
CD 5%	0.04	0.04	0.03	0.03	1.60	8.12	9.76	13.85

Table - 4 : Effect of INM on the Weight of Tuber Grade of of Potato

Treatments	Weight of tuber grade kg plot^{-1}				Tuber yield (qha^{-1})
	0-25g	25-50g	50-75g	>75g	
T1	1.17	5.08	7.34	5.63	160.00
T2	1.79	9.23	11.94	7.99	272.00
T3	1.87	9.94	12.81	8.76	290.00
T4	2.00	10.36	13.37	9.18	302.00
T5	2.03	10.65	13.72	9.44	318.00
T6	2.51	13.99	18.00	12.94	396.00
T7	2.17	11.67	15.04	10.30	334.00
T8	2.06	11.01	14.19	10.71	240.00
MSE	**0.07**	**0.31**	**0.37**	**0.29**	**2.70**
CD 5%	**0.22**	**0.93**	**1.11**	**0.86**	**8.20**

least T1 control i.e., 1.17, 5.08, 6.35 and 4.64. The yield q ha-1 highly influenced by T6 67% RDN through inorganic fertilizer and 33% RDN through FYM + bio – fertilizer (PSB) i.e., 396.00 q ha-1 and followed by T7 33% RDN through inorganic and 67% RDN through FYM +bio – fertilizer (PSB) i.e., 334.00 q ha-1 the least T1control i.e., 160 q ha-1 .

3. COMPERATIVE ECONOMICS OF THE TREATMENTS :

The highest net returns (Rs. 213755.00) and benefit cost ratio (2.07:1) were recorded in T6 with the application 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) followed higher net returns (Rs. 157411.00) and benefit cost ratio (1.50:1) in T7 w i t h application of 33% RDN through inorganic and 67% RDN through FYM +bio – fertilizer (PSB). The lowest net return (Rs. 35474.00) and benefit cost ratio (0.38:1) were recorded in the treatment T1 control.

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AGRICULTURE RESOURCE DEVELOPMENT AT AMETHI REGIONS, UTTAR PRADESH IN INDIA

Arvind Kumar
Department of Agronomy
Shri Karan Narendra Agriculture University, Jobner, Jaipur - 303329, (Rajasthan)
Email: arvind1266@gmail.com

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ABSTRACT

India is an agro based country. The popularity of bio-fertilizer is gradually increasing compost is extremely essential for better crop productivity and maintaining the fertility of soil to ensure sustainable production. Today increasing cost of chemical fertilizers along with declining yield response to increased fertilizer application and degradation of soil.Bio-fertilizers a cheap and safe agriculture resource for farmers provides lot of scope for local employment through decentralized rural infrastructure, more skills and capacities to address technology and production capacities of soils. Bio-fertilizer renovation was started from July, 2009 by Discovery Park Project at Rajiv Gandhi Institute of Information Techonology, CSM Nager. Four block of Amethi tehsil is select for this work 26650 family's use biofertilizers out of 63000 families of the entire blocks. The application of biofertilizer as *Nadep* compost,Vermi compost and Horn compost significantly improve yield and economics of various agricultural crops. On an average, compost contains 0.5-1.2 percent N, 0.2-0.5 percent P2O5 and 0.5-0.8 per cent K2O. Based on this analysis an average dressing of 25 tons/ha of compost supplies 112 kg of N, 56 kg of P2O5 and 112 kg of K2O. These quantities are not fully available to the crops in the year of application. Nitrogen is very slow acting and less than 30 per cent of it is generally available to the first crop. About 60 to 70 per cent of the phosphate and about 75 per cent of the potash become available to the immediate crop. However, organic manures combination with 50% recommended dose of NPK significantly increased crop yield. Bio-fertilizer is especially important for small farmers, who cannot afford high priced fertilizers (even though there is already a nearly 80% subsidy being given to the fertilizer industry). The paper concludes with specific intervention points and recommendations to Bio-fertilizers Innovation for rural capacity building.

Keywords : *Bio-fertilizers, agricultural resource, bio-innovation, organic manure*

INTRODUCTION

With the increasing demand in agriculture it has become important for us to increase the productivity by using various fertilizers, insecticide and pesticide but with the tremendous use of these products the soil has been affected badly because of the depletion in the essential minerals of the soil. So to overcome this problome it has become important for all of us to use a different remedy for the production of various biofertilizer.Biofertilizer provide an economically viablesupport to small and marginal farmers for realizing the ultimate goal of increasing productivity. Biofertilizer are low cost effective and renewable source of plant nutrients to supplement chemical fertilizers. Sustainable crop production depends much on good soil health.

Discovery park pursuing three types of biofertilizer as NADEP, Vermi and Horn composting. Composting is a process of essential meant to utilize soil waste of animal plant origin.

Vermi-compost

Vermicompostplay an important role in the organic farming. It is one of the important methods of compost preparation. Vermicomposting utilizes earthworms for the purpose of producing value added manure. Moreover earthworms ingest litter, dung and other organic matter and grind it in to fine particles, thereby increasing the surface area and promoting faster decomposition. The material passes through the body of the earthworm to produce vermicast. Soil with vermicasts has roughly 100 times more bacteria than soil without worms. Moreover plant growth promoting substances have been reported to be present in vermicast*(Ismail,* 2002). It has been found that vermicompost has nitrogen content of 2.12% phosphorus of 2.01%, potassium of 2.27% and organic carbon of 27.38% *(Perumal,* 2002).In our study, vermicompost had a pH of 6.6 and EC 0.04% was recorded.

RESULTS AND METHODS

In general, there are two methods of vermin composting under field conditions-

1. Vermicomposting of wastes in field pits.
2. Vermicomposting of wastes on ground heaps

Vermicomposting of Wastes in Field Pits

- It is preferable to go for optimum sized ground pits of 20 feet length 3 feet width 2 feet deep for effective vermicomposting bed.
- Series of such beds are to be prepare at one place.

Vermicomposting of wastes on Ground Heaps

- Instead of open pits, vermicomposting can be taken up in ground heaps
- Dome shaped beds (with organic wastes) are prepared and vermicomposting is taken up.
- Optimum size of ground heaps may be 10 feet length x 3 feet width x 2 feet high.

Materials Required for Vermicomposting

- Farm wastes (straw from wheat, soybean, chickpea, mustard etc.) were used for vermicomposting.
- Fresh dung.
- Wastes: dung ratio (1:1 on dry weight basis).
- Earthworm: 1000-1200 adult worms (about 1 kg per quintal of waste material).
- Water: 3-5 liters in every week per heap or pit.

Vermicomopost Preparation by Pit and Heap Methods

Open permanent pits of 10 feet length 3 feet width 2 feet deep were constructed under the tree shade, which was about 2 feet above ground to avoid entry of rainwater into the pits Brick walls were constructed above the pit floor and perforated into 10 cm diameter 5-6 holes in the pit wall for aeration. The holes in the wall were blocked with nylon screen (100 mesh) so that earthworms may not escape from the pits. Partially decomposed dung (dung about 2 month old) was spread on the bottom of the pits to a thickness of about 3-4cm. This was followed by addition of layer of litter/residue and dung in the ratio of 1:1 (w/w). A second layer of dung was then applied followed by another layer of litter/crop residue in the same ratio up to a height of 2 feet. Two species of epigeicearthworms viz., *Eiseniafoetida* and *Perionyxexcavatus* were inoculated in the pit. Moisture content was maintained at 60-70% throughout the decomposition period. Jute bags (gunny bags) were

spread uniformly on the surface of the materials to facilitate maintenance of suitable moisture regime and temperature conditions. Watering by sprinkler was often done. The materials was allowed to decompose for 15-20 days to stabilize the temperature because to reach the mesophilic stage, the process has to pass the thermophilic stage, which comes in about 3 weeks. Earthworms were inoculated in the pit or heap with 10 adult earthworms (1.160.3 g each) per kg of waste material and a total of 500 worms were added to each pit or heap. The materials were allowed to decompose for 110 days. The forest litter was decomposed much earlier (75 to 85 days) than farm residue (110-115 days).

In the heap method the waste materials and partially decomposed dung (1:1 w/w) are made in heaps of dimension; 10 feet length x 3 feet width x 2 feet high and during inoculation channels are made by hand and earthworm @ 1 kg per quintal of waste are inoculated and then watering is done by sprinkler method. Jute cloth pieces are used as covering material.

NADEP compost

NADEP prepared from a wide range of organic materials including dead plant material such as crop residues, weeds, litter and kitchen waste cow dung, dried soil and water etc. Decomposition processes follows through aerobic method and it requires about 90 to 120 days for obtaining the finished products. The main advantage is it improves the physical, chemical and biological condition of the soil. It also supplies the major and micronutrients to the plant growth. It was found that the NADEP manure has nitrogen content of 1.38%, phosphorus of 0.92%, potassium 2.50% and organic carbon of 30.35%. NADEP compost making is an effective way of manure that serves as a good alternative to fertilizer for crop growing.

Description: The recommended size of the NADEP tank is 10 fit (length) X 3 fit (width) X10 fit (height). All four walls of NADEP tank are provided 6 inch vents by removing every alternate brick after the height of 1 fit from bottom for aeration.

Raw material required for filling NADEP tank:

Agricultural waste: (dry & green) : 1530-1400 kg, Cattle dung: 90-100kg, Fine sieved soil: 1675 kg, Water: 1350-1400 liters,

NADEP method

The NADEP method of composting is the latest and widely acclaimed method. It has been developed by Sri N.D. Panaripane at Dr. Kumarappa Gowardhan Kendnl, Pusaad (Maharashtta). The method has been proved to be highly economical and technically feasible at the village level. This method involves following steps.

Construction of tank

In this method, a rectangular tank is constructed on the floor with the help of bricks and puddled mud. The floor is made pucca by placing the bricks. The walls of the tank are 9 inches thick. The inside measurements of the tank are kept as 10ft length and 6 ft width. The height of the tank is kept at 3 ft and 3 inches. The tank of this size provides 200 cu ft area. To ensure proper aeration inside the tank, two-brick-sized holes are provided in each third row of bricks of the length-side-walls. In the width -side walls, one hole in each third row of bricks is open. Care should be taken that the holes do not fall in the same vertical line. The tank has the storage capacity

of 3.5 tonnes and the economic life is expected to be 10 years. The minimum of 10 tanks are desirable for economizing the production of compost

Following materials are required to fill a tank :

a. Vegetative wastes, amounting to 1300 to 1400 kg. Polythenes, stones and glass pieces should be sorted out from the material. "

b. About 100 kg of cattle dung is required. If bio-gas slurry is used then 200 kg.of material is necessary.

c. Nearly 1000 to 2000 litres of water is required. In rainy season water requirement is less.

Depending on the requirement and availability of materials, ratio of the materials kept can be altered. For example, to collect 100 tonnes material one can take 2.5 tonnes of dung, 47.5 tonnes of agro- wastes and 50 tonnes of waste clay.

Filling the tank

Follow the steps given below in sequence. Care should be taken that

the tank is filled within 48 hours of starting or the quality of product will deteriorate.

a. Spray cow dung slurry over the inner side of the wall of the tank..

b. Spread 6" thick layer of agro-waste. In this first layer, coarsest material available should be spread. This will accommodate 100 to 110 kg of agro-waste.

c. Mix 4 kg of dung in l00-125 litres of water and spread it over agro-waste layer.

d. Spread 50 to 60 kg sieved, dry clay soil evenly over the layer. Sprinkle water over it.

All the subsequent layers should be laid in the same sequence. Avoid pressing the layers too much. Fill the tank up to 1.5 ft above the mouth of pit. The top most layer of the tanks assumes a shape of curve being highest in the centre. Generally, 11-121ayersareenough to fill the tank to a required height Plaster the top of the tank using 400 -500 kg moist clay soil. This forms approximately 3 inch thick layer of clay soil. If the clay layer cracks, fill the cracks with dung paste.

After 15-20 days of filling the tank, contents are shrunk to about 8-9 inches below the tank mouth. Again fill the tank by laying layers of residues in the same manner as described before. Bring the height of the tank material up to the original level i.e. 1.5 ft above the mouth of the tank. It takes 90-120 days from first filling for the material to compost adequately. Meantime, light sprinkling of water from time to time and patching up of cracks if formed, should be done to obtain a good quality compost Thatching the tank in too dry or too rainy weather is useful. Check the pit material after 110 days of the first filling. Material will give an earthy smell. When it is granular, dark grey in appearance, take out the pit material till the l20th day. If some undecomposed residues are still left, sort them out and put them back in tank for further composting.

The same pit can be used three times in a year. One tank at one time gives about 3.5 tonnes of compost. That is way one tank can produce 10.5 tonnes of compost in a year. The toil in turning, as is needed in other methods, is also avoided in this method of composting.

Cow Horn Compost

It is made from fresh lactating cow dung packed into cow horns, buried over the winter for fermentation in the earth. Chemically it was found that an increase of nitrate nitrogen from 0.06% to 1.7 %. i.e. about 28.31 times of original content (Pfeiffer, 1958). BD 500 is unique formulation activates regulates the soil by increasing its humus and bacterial content. BD 500 also encourages earthworm activity and allows for better nourishment of the plants (*Purple Hills 2003). T*he important effect of BD 500 is stimulation of root growth, particularly fine hair roots. In our study the BD 500 had a pH of 7.2 and EC 0.17 %. It was found that it has the phosphorus content of 1.10 %, Potassium of 2.50 % and organic carbon of 24.50 %.

Nutrient Properties of These Bio-fertilizers:

Treatment	pH	EC (%)	Nitrogen (N) %	Phosphorus (P) %	Potassium (k) %	Organic Carbon (OC) %
Horn compost	7.2	0.17	1.62	1.10	2.50	24.50
Vermicompost	6.6	0.04	2.12	2.01	2.27	27.38
NADEP	3.7	0.05	1.38	0.92	2.50	30.35

PREPARATION OF BIOFERTILIZER:

The biofertilizer awareness work through Discovery Park was started in July, 2009 at Rajiv Gandhi Institute of Information Technology, Tikermafi, District ChatrapatiSahujiMaharaj Nagar, Uttar Pradesh, a Campus of Indian Institute of Information Technology, Allahabad.

Here, select four block of Amethithasil which is for this work and organize varies training program for the preparation of biofertilizer.

All organic material wastes available on a field (farm) such as weeds, fallen leaves and agricultural wastes were collected. Collected materials were first crushed with the help of crusher machine material composted when it is 1.25 to 3.75 cm in size. Soft succulent tissues did not need chopping in to very small pieces because they decompose very rapidly for the composting process to work most effectively. All the ingredients are mixing equal volume of green material and dry material with cow dung mixed together. These grind particle mix with soil (Soil used because soil has ability to absorb moisture and provided suitable condition for growth of microorganism) uniformly.

Pit site and size: The site of the compost pit was taken a level high enough to prevent rainwater from entering in the monsoon season a temporary shed was to be constructed over it to protect the compost from heavy rainfall and avoided direct contact of environment heat during summer. The pit was made about 1 m. deep, 1.5-2 m. wide and of a suitable length can vary according to the availability of land. The pit was having a slant walls and floor with 90 cm slops to prevent to water logging.

Filling the pit: Making the first pile in the pit base of the pit was sprinkled with water so that it will help in maintain optimum temperature for the growth of microorganism adding organic residues with soil. A unit pile is about 5 m (length), X 1 m (width)X 1 m (height) in size. The pit is sprinkled with water for

adequate moisture content and waste material is sprinkled on it. This procedure is repeated until the pit is full. The pit is covered with a plastic sheet. To maintain the moisture condition to the weekly adequate amount of water is added around the pit, this continues for eight weeks. After eight weeks the whole pile was mixed in order to boost aerobic decomposition.

The pit was turned: The pit was turned after eight week and then again after fourteen week. Normally, the compost is ready after fourteen weeks when the heap has cooled down and the height of the pit has fallen to about 70 cm.

Methods of analysis of organic fertilizer:

Observation: Observation during preparation of material: Material compost best when it is 1.25-3.75 cm in size soft, succulent tissues do not need chopping in to very small pieces because they decompose rapidly. Hard wood material such as dead branches has to crushed with the help of crusher machine before being pilled so it help to microorganism to decompose rapidly.

Observation during filling pile in the pit base of the pit should be sprinkled optimum temperature for the growth of microorganism. Observation on second day the pil covered with the moisture condition, daily adequate amount of water was added around d the pit this is continued for 2-3 weeks. Observation on fourteen days on fourteen days temperature of the pit is higher than the previous observation. Rising of temperature shows thastmicronism start there works of decomposition organic material. Observation of seventh day after one week later, the whole pile is mixed in order to boost aerobic decomposition. During seventh day in some area of pit, decomposition of organic material is observed. It indicate that microorganism fully start there work of composition. Observation on fourteen days the pile is again after two weeks. During fourteen day the rapid decomposition organic material by a reduction of volume and by the materials changing colour to dark brown. As composting nears to completion, the temperature drops. Observation of twenty on days third week on twenty one day height of the pile has fallen to about 70 cm. and little or no heat is observed. Temperature of pit drops to normal condition it shows that biofertilizer is fully prepared from organic waste.

RESULT AND DISCUSSION

Biofertilizer composting is normally ready 120 days. When the heap has cooled down and the height of the pile has fallen to about 70 cm. by analysis result we can confirm that the biofertilizer contain all essential nutrients which are required for plant/ crop growth. This shows that microorganism totally brake down complex organic material waste into simple organic material. It further indicates that we successfully prepared the biofertilizer from the field waste using cow dung solution. Biofertilizer enhance the nutrient availability to crop plants (By processes like fixing atmosphere N or P present in the soil); and impart better health to crop or plants and soil thereby enhancing crop yield in a moderate way. It is a natural method without any problems like salinity and alkalinity, soil erosion etc. In the vast areas of low input agriculture and oil seed production, as also in crops as wheat, maize and vegetables etc. these products will be of much use to give sustainability to production in view of the priority for the promotion of organic farming and reduction of chemical residues in the environment, special focus has to be given for the production of bifertilizer.

CONCLUSION

All the four blocks- Bhader, Bhetua, Amethi and Sangrampur with total families 63180 Discovery Park empower all four blocks family on the above mention items. 26650 families prepared

biofertilizer by waste and obnoxious weeds as behya, parthenium and water hyacinth (jalkumbhi), Biofertilizeruse is effectively increases the yield of Vegetables- Potato, Tomato, Brinjal, Chilli, Cauliflower, Cabbage, Carrot, Radish, Cucumber, Bottlegourd, Bittergourd, Squash, Spongigourd, Redigegourd, Okra, Garlic, Onion, Beans, Peas, Cowpea, Spinach, Pumpkin, Watermelon, Amaranths, Sugerbeet, Corinder, Colocasia, Pointed gourd, Broccoli, Summer onion, Shimla Mirch, Cumin, Methi, Rajma, Babycorn etc., fruits- Papaya, Banana, Sapota, Grapefruit, Litchi, Loquat, Pomegranate, Grape, Citrus, Phalsa, Sweetorange, Mandarin, Strawberry, Mango, Guava, Aonla, Bale, Jamun, Mahua, Karonda, Jackfruit (Kathal), etc., have been extensively used with enthusiasm in each block. It is interesting that the growth of Rajma, broccoli, banana have received great enthusiasm, because earlier there was feeling in the area that such vegetables and fruits cannot be grown there. The compost material used was of the size of 1.25 to 3.75 from this we conclude that hard woody material used in the compost should be crushed with the help microorganism to compost material rapidly. The material used in the pile should have equal volume of green plant material with equal volume of naturally dry plant material to yields such a ratio. A temporary shed may be constructed over pit to protect the compost to avoid direct contact of environmental heat during summer. The pit should have sloping walls and floor with 90 cm slops to prevent water logging. Before making first pile in the pit base of the pit should be sprinkled with water so that it will help in maintain optimum temperature for the growth of micro organism. Biofertilizer preparation helps to increase the number of beneficial microorganism in the soil, microbial health and promotes a healthy environment for **plants.**

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TO STUDY THE EFFECT OF PLANT GROWTH REGULATORS ON GROWTH,YIELD AND QUALITY OF ONION (ALLIUM CEPA L.) CV. 'BHIMA DARK RED' UNDER PRAYAGRAJ CONDITION

Rahul Kumar Patel, Manoj Kumar Singh, Dharmendra Kumar Singh and Vishwanath
Department of Horticulture
Kulbhaskar Ashram Post Graduate College, Prayagraj - 211002, (U.P.), India

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ABSTRACT

The present investigations entitled " To study the Effect of Plant growth Regulators on Growth, Yield and Quality of Onion (*Allium cepa L.*) cv. 'Bhima Dark Red' Under Prayagraj condition"was conducted at Research Farm, Department of Horticulture,Kulbhaskar Ashram Post Graduate College Prayagraj (U.P.) during the Kharif season of 2022-2023.The experiment was laid out in Randomized block design replication thrice with nine treatment viz. GA3 @ 100 ppm, GA3 @ 200 ppm, IAA @ 100 ppm, IAA @ 200 ppm, NAA @ 100 ppm, NAA @ 200 ppm, ETHREL @ 500 ppm, ETHREL 1000 ppm and control. The aim of investigation was to find out best economical PGRs treatment for *Kharif* onion which, produce higher growth yield with optimum quality of onion.The application of GA3 @ 100 ppm was perform better the treatments and produce maximum marketable& total yield (232 q/ha, 237.20. q/ha respectively)the treatment also produce higher plant height (50.60 cm), number of leaves (11.60), fourth leaf length (37.89 cm), fourth leaf width (2.50 cm), leaf area index (3.52), polar diameter (3.66 cm), equatorial diameter (5.16 cm), average weight of bulb (84.50 g), average dry weight of bulb (33.80 g), net profit (170637.64 Rs./ha), B:C ratio (2.56) and lower neck thickness (0.96 cm). Whereas the application of NAA @ 200 ppm produces thicker neck bulbs (1.18 cm) and higher bolting with GA3 @ 200 ppm application (8.00 %), whereas GA3 @ 100 ppm applied plants bolted less. In all aspect of economic GA3 @ 100 ppm treatment performed better than the other treatments. It can be inferred from the study that GA3 at 100 ppm applied as foliar application is ideal and plant growth substance for *Kharif* onion production.

Keywords : *Onion, effect, plant growth regulators*

INTRODUCTION

Onion (*Allium cepa*L.) is one of the most important bulbous vegetable crop. It is monocot vegetable, belong to family Alliaceaeorder *Aspergales*composed of 795 species in genera. Its is chromosome number is 2n=16. It is an important vegetable crop grown in India. India export 12 percent of total world export of onion. Onion is grown through out the entire world with some major producing country like China, India, USA, Turkey, Pakistan, Iran, Japan, Spain and Brazil. India ranks second in area and production in the world after China and third in export after Netherlands and Spain.India onion are famous for their pungency and

are available round the year. Maharashtra, Karnataka, Gujarat, Orissa, Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Rajasthan and Bihar are the major onion producing states in India. Onion bulb and greens both are rich in vitamin C, potassium, dietary fibre, minerals and folic acid. It also contains calcium, iron, high quality protein and trace of sodium and fat. The 100 g of fresh onion bulb contains 86.00 g moisture, 10.90g carbohydrates, 1.40g protein, 0.10g fat, 0.80mg fibre, 180.00 mg potassium, 70.00 mg sulphur, 44.00 mg phosphorus, 32.00 mg calcium, 25.00 mg chlorine, 16.00 mg magnesium, 7.00 mg sodium, 9.70 mgiron, 0.06 mg thiamine, 0.01 mg riboflavin, 0.40 mg niacin, 28.00 mg vitamin C, 47.00 cal calorific value and 0.005% essential oil (Breuand Dorsch, 1994).

MATERIALS AND METHODS

The experiment was carried out was in a Randomized Bock Design (RBD) at the Department of Horticulture, Kulbhaskar Ashram Post Graduate College, Prayagraj during the Kharif season of year 2022-2023.This region falls under 4th Agro climatic zone of Utter Pradesh state. The experiment was laid out in a 3 replication, 9 treatments viz., T1: GA3 @ 100 ppm, T2: GA3 @ 200ppm, T3: IAA @ 100 ppm, T4: IAA @ 200 ppm, T5: NAA @ 100 ppm, T6: NAA @ 200 ppm, T7: ETHREL @ 100 ppm, T8: ETHREL @ 200 ppm, T9: Control. Total no. of plots: 27, Row to Row distance: 15cm, Plant to Plant distance: 10 cm, Net plots size: 1.5m × 1m = 1.5m^2,Observation intervals: 30, 60, 90 days.The source of onion seed obtained from Sangam seed Bhandar Varanasi and source of PGRs from purchase in authentic and reputed dealer sing agri clinic Varanasi. The observations recorded on different growth, yield and quality parameters were recorded on ten randomly selected competitive plants of each plot for all replications. The observationson growth characters like plant height, number of leaves per plant, collar length, collar width, fourth leaf length, fourth leaf width, leaf area index and chlorophyl valve (SPADunit), yield and yield attributing charactersi.e.polar diameter, equatorial diameter, neck thickness, average weight of bulb, average dry weight of bulb, different grades of bulbs (A+, A, B, C and D) marketable yield, and total yield, quality characters such as total soluble solids and bolting percentage were recorded on plant and net plot basis. The Cost of production for all treatment was worked out on the basis of prevailing input cost and market price of the produce. The net profit/ha was calculated by deducting the cost of production (Rs./ha) from the gross profit/ha. Ultimately, treatment wise benefit cost ratio was calculated to assess the economic impact of the treatment by dividing the net realization/ha by the cost of production (Rs./ha). The statistical analysis of variance was carried out for each character separately asper method of Panse and Sukhatme, (1967). Significance of differences among genotypes was tested using the following sketeton.

RESULTS AND DISCUSSION

The experiment showed that the application of Plant growth Regulators application by hand knapsack sprayer at two foliar application 20 and 30 DAT of the crop. Significant difference in all parameter like

1. Growth parameters in Plant High, Number of Leaves, Collar Length, and Collar diameter.

The results higher plant height at 90 DAT (50.60 cm) was recorded in treatment T1 GA3 @ 100 ppm and lower plant height in treatment T3 IAA @ 100 ppm (43.87 cm). Higher number of leaves per plant at 90 DAT (11.60) was counted in treatment T1 GA3 @ 100 ppm and minimum was recorded in the treatment T8 ETHREL @ 1000 ppm (9.73).The higher collar lengthat 90 DAT (3.95 cm) was recorded in treatment T2 GA3 200 ppm and lower collar length (3.20 cm) recorded treatment T8

ETHREL @ 100 ppm. The higher collar diameter at 90 DAT (1.77 cm) was recorded in treatment T4 IAA @ 200 ppm and lower collar diameter (1.46 cm) was recorded in treatment T2 GA3 @ 200 ppm.(Table1).

Table - 1 : Effect of Plant Growth Regulators on the growth parameters on Onion

S.N.	Treatments	GrowthParameters											
		Plant Height (cm)			Numberof Leaves			Collar Length (cm)			CollarWidth cm)		
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
1.	GA3@100ppm	23.20	43.70	50.60	4.20	9.67	11.60	1.83	2.63	3.56	0.41	1.32	1.51
2.	GA3@ 200ppm	23.83	41.86	45.10	4.27	9.00	10.13	2.05	2.93	3.95	0.38	1.25	1.46
3.	IAA@100ppm	20.75	43.50	43.87	3.80	8.60	11.47	2.04	2.61	3.65	0.35	1.39	1.72
4.	IAA@200ppm	21.79	42.35	49.23	4.07	8.40	10.87	1.71	3.32	3.56	0.35	1.33	1.77
5.	NAA@100ppm	20.59	45.79	48.59	4.47	9.33	11.40	1.85	2.91	3.41	0.42	1.44	1.75
6.	NAA@200ppm	22.38	42.02	47.95	3.93	9.27	10.67	2.01	3.03	3.63	0.35	1.36	1.59
7.	ETHRSL@ 500ppm	21.99	40.34	44.62	4.40	9.40	10.73	2.11	2.92	3.34	0.36	1.35	1.51
8.	ETHREL@ 1000ppm	27.14	40.40	44.25	4.67	8.20	9.73	2.10	2.73	3.20	0.41	1.30	1.53
9.	CONTROL	22.85	40.45	46.07	4.20	8.40	9.93	1.67	3.59	3.67	0.34	1.27	1.50
	SEm±	NS	0.94	1.29	NS	0.32	0.38	NS	0.18	NS	NS	NS	NS
	CD(P=0.05)		2.84	3.87		0.96	1.14		0.54				

2.Growthparameters in Fourth leaf Length, Fourth leaf Diameter, Leaf Area Index.

The results maximum fourth leaf length 90 DAT (37.89 cm) was recorded in treatment T1 GA3 @ 100 ppm and minimum was recorded treatment T9 Control (33.87 cm). The maximum fourth leaf diameter 30 DAT (2.50 cm) was recorded in treatment T1 GA3 @ 100 ppm and minimum was noted treatment T9 Control (2.08 cm). The maximum leaf area index at 90 DAT (3.52) was recorded in treatment T1 @ 100 ppm and minimum leaf area index noted treatment T9 Control (2.86).

Table - 2 : Effect of Plant Growth Regulators on the growth parameters on Onion

S.N	Treatments	Growth Parameters										
		Leaf Length (cm)			Fourth Leaf width(cm)			Leaf Area Index (cm)			Chlorophyll Valve	
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	90 DAT	120 DAT
1.	GA3	21.02	37.41	37.89	0.85	2.32	2.50	1.21	2.78	3.52	36.16	35.29
2.	@100ppmGA3 @	21.98	33.63	37.66	0.77	2.25	2.41	1.23	2.75	3.46	35.95	33.57
3.	200 ppmIAA @	18.27	33.01	37.41	0.80	2.23	2.38	1.09	2.71	3.34	36.18	33.17
4.	100	20.06	31.65	35.34	0.78	2.20	2.36	1.11	2.59	3.28	32.58	34.38
5.	pmIAA@200ppm	19.01	32.01	35.59	0.80	2.21	2.37	1.29	2.d7	3.30	32.70	35.42
6.	NAA@100ppmN	20.14	31.61	35.32	0.79	2.13	2.29	1.15	2.52	3.13	3d.24	33.94
7.	AA@200ppm	19.56	29.87	34.27	0.75	2.04	2.21	1.27	2.42	2.92	35.03	33.96
8.	ETHREL@ 500ppm	24.47	30.30	34.55	0.84	2.13	2.29	1.34	2.45	2.92	36.69	35.75
9.	ETHREL@ 1000ppm CONTROL	19.55	28.59	33.87	0.83	1.97	2.08	1.21	2.36	2.86	34.47	33.33
	SEm	NS	1.51	0.91	NS	0.07	0.07	NS	0.09	0.03	NS	NS
	CD(P=0.05)		4.53	2.74		0.21	0.22		0.28	0.08		

3.Yield parameters in Polar daimeter, Equatorial diameter, Neck thickness, Average weight of bulb, Average dry weight of bulb.

The results maximum polar diameter(3.66 cm) was recorded in treatment T1 GA3 @ 100 ppm and minimumpolar diameter noted treatment T9 Control (3.27 cm).The maximumequatorial bulb diameter (5.16 cm) was recorded in treatment T1 GA3 @ 100 ppm and minimum was recorded treatment T9 Control (2.50 cm). The maximum neck thickness (1.18 cm) was recorded in treatment T9 NAA @ 200 ppm and minimum was recorded in treatment T1 GA3 @ 100 ppm (0.96).The maximum average bulb weight (84.50 g) was observed in treatment T1 GA3 @ 100 ppm and minimum was noted under treatment T9 Control (55.81 g).The highest average dry weight of bulb (33.80 g) was observed in treatment T1 GA3 @ 100 ppm and lowest was recorded in treatment T8 Control (22.32 g).(Table 3).

Table - 3 : Effect of Plant Growth Regulators on Yield of Onion

S.N	Treatments	Yield Parameters				
		Polar diameter (cm)	Equatorialdiameter (cm)	Neck thickness (cm)	Average weight of bulb(g)	Average dry weight of bulb(g)
1.	GA3@100ppm	3.66	5.16	0.96	84.50	33.80
2.	GA3@200ppm	3.61	4.87	1.11	80.11	32.04
3.	IAA@100ppm	3.49	4.80	1.17	78.56	31.42
4.	IAA@200ppm	3.46	4.24	1.12	76.02	30.40
5.	NAA@100ppm	3.48	3.50	1.08	75.13	30.05
6.	NAA@200ppm	3.43	3.10	1.18	70.06	28.02
7.	ETHREL@ 500ppm	3.39	3.00	1.00	64.32	25.72
8.	ETHREL@ 1000ppm	3.41	2.95	1.06	67.00	26.80
9.	CONTROL	3.27	2.50	1.13	55.81	22.32
	SEmA	0.08	0.19	0.04	5.78	1.84
	CD(P=0.05)	0.23	0.58	012	14.36	5.24

4.Yield parameter in grade wise yield, Marketable yield and Total yield.

The results A+ grade blubs highest in treatment T1 GA3 @ 100 ppm (3.76 t/ha) and lowest was obtained in treatment T9 Control (5.11 t/ha). The 'A' grade blubs yield highest in treatment T3 IAA @ 100 ppm (8.23 t/ha) and lowest was obtained in treatment T5 NAA @ 100 ppm (3.99 t/ha). The 'B' grade blubs yield highest in treatment T3 IAA @ 100 ppm (5.00 t/ha) and lowest yield was noted in treatment T9 Control (2.00 t/ha). The 'C' grade blubs yield highest in treatment T8 ETHREL 1000 ppm (2.20 t/ha) and lowest yield was noted in treatment T4 IAA @ 200 ppm (1.10 t/ha). The 'D' grade blubs yield highest in treatment T1 GA3 @ 100 ppm (0.52 t/ha) and lowest was obtained in treatment 9 Control (0.31 t/ha). The highest marketable yield was recorded in treatment T1 GA3 @ 100 ppm (23.20 t/ha) and lowest was recorded in treatment T9 Control (12.91 t/ha). The highest total yield was obtained in treatment T1 GA3 @ 100 ppm (23.72 t/ha) and lowest was recorded treatment T9 Control (13.22 t/ha).(Table 4).

Table - 4 : Effect of Plant Growth Regulators on Yield of Onion

S.N	Treatments	Gradewiseyield(t/ha)					Mrketable yield(t/ha)	Total yield (t/ha)
		A*	A	B	C	D		
1.	GA3@100ppm	9.67	6.50	4.93	2.10	0.52	23.20	23.72
2.	GA3@200ppm	8.60	6.50	4.65	2.05	0.51	21.80	22.31
3.	IAA@100ppm	6.20	8.23	5.00	1.98	0.50	21.41	21.91
4.	IAA@200ppm	7.33	5.69	3.41	1.10	0.45	17.53	17.98
5.	NAA@100ppm	5.77	3.99	3.41	1.67	0.39	14.84	15.23
6.	NAA@200ppm	9.53	6.66	2.72	2.11	0.41	21.02	21.43
7.	ETHREL@ 500 ppm	8.88	8.00	3.11	1.55	0.49	21.54	22.03
8.	ETHREL @ 1000ppm	9.22	4.32	2.33	2.20	0.35	18.07	18.42
9.	CONTROL	5.11	4.04	2.00	1.76	0.31	12.91	13.22
	SEm	0.17	0.83	1.20	0.27	NS	1.54	1.55
	CD(P=0.05)	0.50	2.50	3.59	0.80		4.63	4.63

5.Quality parameters in Total soluble solid TSS (%) and Bolting percentage.

The results maximum TSS (12.88 %) was recorded treatment T6 NAA @ 200 ppm and minimum TSS was recorded treatment T3 IAA @ 100 ppm (11.59 %).The maximum bolting percent (8.00 %) was recorded in treatment T2 GA3 @ 200 ppm. and minimum was recorded bolting percent treatment T7 ETHREL @ 500 ppm (1.00 %).(Table 5).

Table - 5 : Effect of Plant Growth Regulators on Quality of Parameters

S.N.	Treatments	Qualityparameters	
		Totalsolublesolids(%)	Bolting(%)
1.	GA3 @100ppm	11.83	6.00
2.	GA3 @200ppm	12.43	8.00
3.	IAA @100ppm	11.59	3.00
4.	IAA@200ppm	12.27	3.00
5.	NAA@100ppm	11.89	5.00
6.	NAA@200ppm	12.88	2.00
7.	ETHREL@500ppm	12.74	1.00
8.	ETHREL@1000ppm	12.51	2.00
9.	CONTROL	12.45	4.00
	SEmz	NS	0.41
	CD(P=0.05)		1.23

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DISCOVERY PARK IN RURAL EMPOWERMENT : A NEW TECHNIQUE OF AGRICULTURE EXTENSION

Arvind Kumar
Department of Agronomy,
Shri Karan Narendra Agriculture University, Jobner, Jaipur - 303329, (Rajasthan), India
Email-arvind1266@gmail.com

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ABSTRACT

Agriculture development is a precondition of our national prosperity. It is our main source of earning livelihood of the people; nearly two-third of its population depends directly or indirectly on agriculture. Agriculture not only provides food and raw material but also employment opportunities to a very large proportion of population. Efforts has been initiated to strengthen of farmers of Amethi by providing training and awareness programme for income generation actives using natural resources management. A vast area under unutilized land and backyard of houses which was not under cultivation for a long time was focused for utilization. This area was focused to convert in to profitable farming technique for empowerment. Group of farmers of landless and marginal farmers select and trained for good agricultural package of practice in agri-horti-dairy and fish production. The intervention led to increase in the area under profitable agriculture production due to awareness created to the farmers with use of high yielding verities, use of farm waste, bio-fertilizer, vermin compost, and need base spraying of vermin wash and neem based bio-pesticide. The pilot study is being undertaken in four block of Amethiregarding the impact of S&T Discovery Park in rural empowerment for agricultural growth, cultivation patterns, productivity performance, linking with markets including value chains and employment generation.

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Keywords : *Sustainable agriculture, ruralempowerment, crop residues, organic agriculture.*

INTRODUCTION

The empowerment of rural farmers generally refers to the process of improving the quality of life and economic of the nation. According to the census of India, 2011, the population of India is more than 1.21 billion and out of it 72.20% population belongs to the rural area. Agriculture plays a vital role in the Indian economy. Although its contribution to gross domestic product (GDP) is now around 16.5 per cent, it provides employment to 56 per cent of the Indian workforce. Small holdings agriculture which is the focus of this paper is important for raising agriculture growth, food security and livelihoods in India. It may be noted

that Indian agriculture is the home of small and marginal farmers (80%). Therefore, the future of sustainable agriculture growth and food security in India depends on the performance of small and marginal farmers. Indian Agriculture is facing challenges due to several factors such as increased competition for land, water and labour from non-agricultural sectors and increasing climatic variability. The climatic variability associated with global warming will result in considerable a biotic and biotic stresses, seasonal/annual fluctuation in food production. The natural resources, which we have, are limited especially the land and water. Raising productivity constant or even decrease due to increasing pressure on land for non-agricultural uses. Water is also becoming scarce and single most important critical factor for agricultural productivity which is now becoming a major limiting factor for crop production.

The S & T Discovery Park for Rural Empowerment was started from July, 2009 at Rajiv Gandhi Institute of Information Technology, Amethi work very effectively of the following Blocks: Bhader, Bhetua, Amethi and Sangrampur for rural empowerment activates. It has conceive to reach the rural people with various solutions of their day to day problems such as – Bio-fertilizer, Herbal-medicinal plants, Dairy production, Fisheries, Bio-Pesticide, agri- horticultural crops, bio-fuels and various information regarding health, hygiene etc. Rural empowerment through testing and transfer of agricultural technologies to association the gap between production and productivity to increase self employment opportunities among farming communities.

The objective of this paper is to examine the role and challenges of agricultural growth, food security and livelihoods. The paper also shows that market oriented reforms are not sufficient and government intervention and other support are needed for small holdings to achieve the above goals. It is known that small farmers face several challenges in the access to inputs and marketing. They need a level playing field with large farms in terms of accessing land, water, inputs, credit, technology and markets.

General Profile of Amethi:

Amethi situated in latitude 26 degree 9 minute north and longitude 81 degree 49 minute east at an average elevation of 101 metres (331 feet) from mean sea level. The districts head quarter is Gauriganj. The total geographic area of the districts is about 3063 Sq.Km. out of these all four block of Amethiteshil (Bhader, Bhetua, Amethi and Sangrampur) area is 635.01 Sq.Km.General and agricultural information of Amethiteshilin Table-1&2.

The land of Amethi is generally plane except some regions around the Gomti River which drains almost the whole district. It may be called an agrarian area as agriculture is the main occupation of the people.Amethi has a wet and dry climate with average temperatures ranging between 23°C to 28 °C. Amethi experiences three distinct seasons: summer, monsoon and a mild autumn. Typical summer months are from March to May, with maximum temperatures ranging from 36 to 44 °C. The rainy season in the district falls between June and September and July being the wettest month of the year. Winter starts from November. The daytime temperature hovers around 22 °C while night temperature is below 08 °C during December and January, often dropping to 2-3 °C.

The rich variety of flora and fauna cover an area of 3749 hectares in 2009-2010. The commercial tree like Aonla, Kathal, Mango, Mahuwa, Jamun, wood apple and Eucalyptus are found in the forest.

Table : 1 - General information of the block locate at Amethiteshil as following:-

S.N.	Object	Bhader	Bhetua	Amethi	Sangrampur	Total sum
1.	Total grampanchyat	47	34	44	32	157
2.	Total family	17667	14312	18736	10471	61186
3.	Total beneficiary family	14676	10986	11964	10113	47739
4.	Total BPL family	10794	10391	10572	6429	38186
5.	Total population	105894	84889	105818	79780	376381
6.	Total SC population	22451	17717	21058	12896	74122
7.	Education %	57.75	55.83	75.25	59.33	62.04

Table : 2 - Agricultural Information of the block locate at Amethiteshil as following:-

S.N.	Object	Bhader	Bhetua	Amethi	Sangrampur
1.	Total Land (ha)	15944	16528	15176	10182
2.	Total Forest Land (ha)	70	1	7	627
3.	Total Cultivated & Waste Land (ha)	310	329	211	199
4.	Current Fallow (ha)	2759	1673	1128	1239
5.	Saline and Waste Land (ha)	691	795	348	288
6.	Grass land (ha)	159	212	95	69
7.	Horticultural Orchards Area (ha)	571	708	517	640

Discovery Park extension work for rural empowerment:

The term empower means to enable, to allow, or to permit and can be viewed as both self-initiated and initiated by others. Extension has mainly involved technology transfer, transferring knowledge from research stations to farmers by using individual, group, and mass media methods. More recently, extension has been asked to play a "technology development role" by linking research with community group needs and helping to facilitate appropriate technology development. Approach system of farmers for rural empowerment:

- By Farmers Workshop
- By Farm/field Visit
- By Phone
- By Farmers Ghosti (Grampanchyat Level)

Approaches and Methodology:

The approach has been designed to improve livelihood option for empowering farmers of the study area by using natural resource management. The study has been inititiated in four block of Amethi about 61186 families of the study block were interview and group meeting were conducted. Farmers of the study area have been targeted as direct beneficiaries under the project. The group largely comprises farmers from marginal, small farm households and land less (Table-3&4). Project intervention directly towards poor farmers who have not benefited other program conducted by other organization and need support for livelihood.

Table : 3 - Below one acre land holding families of the block locate at Amethiteshil as following:-

S No	Block Name	Total family	Total below one acre landholding family	GEN	OBC	SC
1	Bhader	17667	5569	1806	1992	1768
2	Bhetua	14312	4314	1388	1428	1502
3	Amethi	18736	6094	2334	2283	1477
4	Sangrampur	10471	3835	1248	1507	1079
	Total Sum =	**61186**	**19812**	**6776**	**7210**	**5826**

Table : 4 - Land less families of the block locate at Amethiteshil as following:-

S No	Block Name	Total family	Total land less family	GEN	OBC	SC
1	Bhader	17667	2387	239	718	1433
2	Bhetua	14312	2876	254	892	1726
3	Amethi	18736	4063	528	1097	2438
4	Sangrampur	10471	2557	384	895	1279
	Total Sum =	**61186**	**11883**	**1405**	**3602**	**6876**

Discovery Park activities for rural empowerment

To begin with, group meetings were conducted with the target group in the study area on key issues of livelihood options for long-term sustenance. Group has been identified in each village to motivate on natural resource management and biodiversity conservation. The emphasis has been placed on the following points:

1. E-agriculture and Traditional Agriculture

- Herbal :-(Occimum, Satawer, lemongrass, Ashvagandha, Safedmushli,Mentha, Stevia, Kalmegh, Alovera, Khus, Brahmi
- Vegetable:- (Potato, Tomato, Brinjal, Chilli, Cauliflower, Cabbage, Carrot, Radish, Cucumber, Bottlegourd, Bittergourd, Squash, Spongigourd, Redigegourd, Okra, Garlic, Onion, Beans, Peas, Cowpea, Spinach, Pumpkin, Watermelon, Amaranths, Sugerbeet, Corinder, Colocasia, Pointed gourd, Broccoli, Summer onion, Shimla Mirch, Cumin, Methi, Rajma, Babycorn)
- Inter-cropping :-(Suren, Turmeric and Zinger)
- Fruit crop:- (Papaya, Banana, Sapota, Grapefruit, Litchi, Loquat, Pomegranate, Grape, Citrus, Phalsa, Sweetorange, Mandarin, Strawberry, Mango, Guava, Aonla, Bale, Jamun, Mahua, Karonda, Jackfruit (Kathal)
- Food Processing Program in four blocks- Rural Empowerment with 'Post harvest management and processing Technology
- Floriculture:- (Marigold, tuberose, Rose, Gladiolus, Mogra, Gaillardia, Calendula)
- Cereals & Pulses Crops

2. **Bio-diesels & Bio-fuels**

- Bio-fuel:-Jatropha production, distribution of plants to farmers.

3. **Bio informatics**

- Biofertilizer:- (NADEP, Vermin, Horn compost, Green-manuring)
- Dairy management and Animal Husbandry: - (cow, buffalo and goat)
- Poultry development
- Bee-Keeping
- Fisheries:- development
- Bio-Pesticide:- (Neem Based Bio-pesticide for the control of insect-pest and disease, Neelgai Beat Based Bio-pesticide for the control of Neelgai)

Demonstrative Plants and Agricultural implements in RGIIT campus (A campus IIITA)

- Development of "Herbal Garden" for demonstration and distribution of herbal and medicinal plants, for example, Alovera, Ashwagandha, Lemongrass, Bramahi, Satawer, Bringhraj, Occimum, Bavachi, Viksa (Kumkum), Jamalghotas, Sarpgandha, Gurmar, Stevia, Giloe etc., which is very popular.
- Demonstrative vegetables- peas, rajma, broccoli, lettuce, garlic, smilamirch, kharif onion and other which are not grown commonly in this area.
- Develop demonstrative Tissue Culture banana to farmers for their awareness.
- Jatropha field demonstration for Bio-fluel production
- Bio-fertilizer demonstration as NadepVermi, Horn Compost unit and Green manuring for the promotion of organic cultivation.
- Agricultural implements as Rotavater, Harrow, Thrasher, Seed-cum-fertidrill, Sprayer, leveler, Cultivator for farmers use.


Demonstrate NADEP and Vermi compost by Discovery Park Scientist


Field visit with farmers and demonstrate herbal plants by Discovery Park Scientist


Demonstrate Broccoli by Discovery Park Scientist


Demonstrate Strawberry by Discovery Park Scientist

People's Participation :

The group meeting conducted in selected study villages. They have shown keen interest on the subject and willing to involve for undergoing training and capacity building. Key species as indicators of natural resources has been documented as outcome of the group meetings and participation of farmers during the study. Most of the participants have shown their interest requesting useful training and awareness program for developing theirskills towards natural resource management and

biodiversity conservation.

Discovery Park organizes farmer's workshop and training program by prominent scientist and professor of the nation as Prof. R. K. Pathak, Dr. A.K. Pandey, Dr. D.N. Dhar, Dr. J.P. Tiwari and more than 300 farmer's gosthi at block grampanchyat for farmer's skill development and gives recent advance technology.

Discovery Park , RGIIT, Tikarmafi, Amethi, (A campus IIITA)


Farmer's Workshop Field Demonstration


Jatropha Seeds Demonstration at RGIIT Campus


Farmers' Workshop Herbal Plantation

Training on by Discovery Park R.P. Sharma, Expert & Scientist Arvind Kumar

Training Crop Production by Discovery Park Expert& Scientist Arvind Kumar

Practice of agriculture program of all four Blocks of Amethi :-

Farmers have undertaken the following activities based on inspiration from Discovery Park demonstration, training and advice (Table-5):-

Bio-fertilizer: Bio-fertilizers are prepared by farm waste and obnoxious weeds as behya, parthenium and water hyacinth (jalkumbhi). 26186 growers have adopted various types of innovative ideas through the discovery park bio-fertilizer as NADEP, vermin, horn-composting and green-manureing start carefully of the selected blocks grampanchyat this is the traditionally and best system of soil health improvement most of the land is sodic and poor health farmers adopt these techniques for soil health improvement and also its marketing . The vermi-verm is 100-150 rupees/kg and vermin compost is 15-20 rupee/kg.

Farmers prepare NADAP pit with the guidance of Discovery Park Project, scientist

Farmers prepare Vermi pit with the guidance of Discovery Park scientist

Herbal: Discovery park distribute herbal plants to 39817 beneficiaries to grow herbal plants and its part use various diseases cure as lemongrass, occimum, ashwgandha, alovera, vach, satawer, brahmi and more than 100 species of herbals available at discovery park herbal garden. The most of farmers

planted occimum and lemongrass for using various treatment and commercially grown lemongrass, occimum, satawer, safedmusali, mentha get Rs.30000-50000 thousand rupees/Acre.

Vegetable: Many growerscultivate commercial vegetable growing like as pea, rajma, cucurbits, broccoli, tomato, parval (pointed gourd) and chili these vegetable seeds provided by IIVR, Varanasi. 27285 vegetable growerlargely grow vegetable pea and fetch Rs.30000-40000 thousand rupees within two months. Rajma, broccoli and summer onion is the new farm of horticultural crop get ready just 3.5 month and obtain Rs.40000-50000 thousand rupees farmers start commercially. Cauliflower, brinjal, tomato, chilli, bittergourd and pointed gourd are the incredible area of all four block and earn Rs.60000-70000.

Farmers field of Suren, tomato peas and parvalDiscovery Park Scientist

Orchard plantation 'Fruit crop': Growers plant tissue culture banana, papaya, mango, aonla, bale orchard collected from CISH and bio-tech park, Lucknow under the supervision of discovery park. 17253 farmersOrchard and fruit plantation is gradually improved.

Floriculture: 1715growersgrowMarigold, Gladiolus, Rose and other annual flower grow commercially with the instruction of Discovery park project and sold 80-100 Rs./kg (Marigold), 180-200 Rs./kg (Rose) Chandria, Shitlaganj, Tikermfi, Kamasin are the main producing grampanchyat. Seasonally discovery park staff distributes annual flowers for the awareness and promotion of the floriculture field.

Cereals & Pulses: 13596 farming families of Amethi surrounding villagers start line sowing of various crop as wheat, pea, mustered, gram, lentil, with the help of seed cum fertidrill implement which is available in discovery park and farmers save 25-30% seeds/ha. More than 100 Farmers start direct sowing of rice through seed cum fertidrill in the month of june seed rate is 32 kg/hectors farmers save 30% cost of rice production.

Farmers field of Basmati paddy and Seed drill Discovery Park Scientist

Dairy management and Animal Husbandry: 9197farmersAnimal husbandry and dairy production is great success of in all four blocks Discovery Park has advise more than 9197 thousand families for increase milk production, cattle's improvement, chilling centre development and establish dairy smite. The surrounding of Amethi per day 100000 liter milk production and 30% families earn rupees 200/day by the milk production.

Bee-Keeping: 1240 Training on Bee-Keeping of 80 farmers with the Baroda Swarojgar, Amethi and provide 5 bee-heaves sets of the farmers by NHM and start bee-keeping and produce shed 8-10 kg/annum/heaves and sold Rs.@150-250/kg.

Biofule:jatropha: 19298 Bio-fule crop jatropha provided to farmers for using waste and undulated

land of these plant for waste land management and sale its seed to bharat petroleum 5 rupees/kg. Also a benefits of protection wild cattle's (Neelgai)

Fisheries development: 316 families engaged in fisheries production after attending fisheries training program from NBFGR, Lucknow, offered 5 days **Fisheries Training** program for the 28 farmers of all blocks with the support of Discovery Park Project. Beneficiary's trainee starts fisheries production and produces 6-10 qu/acre/year and fetch around Rs. 50000-80000/- per annum. Discovery Park Beneficiary's Mr.Saurabh Singh, nominate national innovative ideas in fish production and offered to Nation award by the NBFGR,Lko

Farmers field of fisheries Discovery Park

Bio-Pesticide: Bio-pesticide through neem extract, behya and herbal extract control all the sucking insects and pests and also improve soil and plant health more than 23752 families use various type of bio-pesticide for the safety of and insect-pest and diseases protection and save aprox. 1500 Rs./Acre in vegetable and other crop production.

Telemedicine Center: Discovery Park communicate to 105 families for health advice of chronic diseases, through telemedicine centre which is for the rural health care as namely Oncology (Cancer), Endocrine system (Diabetes), Cardio vascular (Blood-presser), T.B. Chest (Tuberculosis), Skin-VD (Leprosies), GIT disorder, Neurovascular (Epilepsy), ENT, Gynea&Obs, Ophthalmology and other.

Table : 5 - Beneficiaries detail of the block locate at Amethiteshil as following:-

S.N.	Objectives	Bhader	Bhetua	Amethi	Sangrampur	Total sum
1.	**Bio-fertilizer**	8309	6458	6292	5127	26186
2.	**Herbal**	12241	11070	8931	7575	39817
3.	**Vegetable**	8582	6386	6153	6164	27285
4.	**Orchard plantation 'Fruit crop'**	4917	3817	4168	4371	17253
5.	**Floriculture**	436	521	282	476	1715
6.	**Cereals & Pulses**	3690	4202	3301	2403	13596
7.	**Dairy management and Animal Husbandry**	2484	1912	2170	2631	9197
8.	**Bee-Keeping**	320	243	302	375	1240
9.	**Biofule: jatropha**	4952	4397	5202	4747	19298
10.	**Fisheries development**	97	77	61	81	316
11.	**Bio-Pesticide**	8101	5383	6366	3902	23752
12.	**Telemedicine Center**	37	20	30	18	105

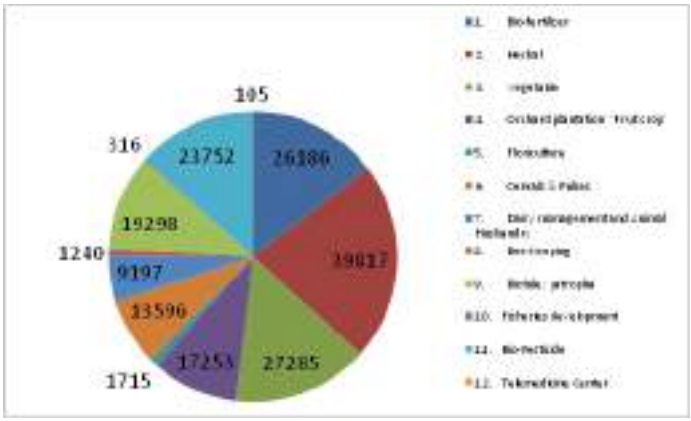

Chart show beneficiaries in all four block of Amethi

Concluding Observation :

All the four blocks- Bhader, Bhetua, Amethi and Sangrampur with total families 61186 have been covered under Discovery Park Project. Thus far, 26650 families are producing and using Bio-fertilizer with farm wastes and natural resources, 39150 families have been distributed herbal plants for their use with enthusiasm and keen interest especially for their seasonal and preventive requirements. Some of common herbal plants- Occimum (Tulsi), Satawer, Lemongrass, Ashvagandha, Safedmushli, Mentha, Stevia, Kalmegh, Alovera, Khus, Brahmi etc., are highly popular in each block. Mentha, Lemongrass, occimum were extensively cultivate.

Out of vegetables and fruits, the following: Vegetables- Potato, Tomato, Brinjal, Chilli, Cauliflower, Cabbage, Carrot, Radish, Cucumber, Bottlegourd, Bittergourd, Squash, Spongigourd, Redigegourd, Okra, Garlic, Onion, Beans, Peas, Cowpea, Spinach, Pumpkin, Watermelon, Amaranths, Sugerbeet, Corinder, Colocasia, Pointed gourd, Broccoli, Summer onion, Shimla Mirch, Cumin, Methi, Rajma, Babycorn etc., fruits- Papaya, Banana, Sapota, Grapefruit, Litchi, Loquat, Pomegranate, Grape, Citrus, Phalsa, Sweetorange, Mandarin, Strawberry, Mango, Guava, Aonla, Bale, Jamun, Mahua, Karonda, Jackfruit (Kathal), etc., have been extensively used with enthusiasm in each block. It is interesting that the growth of Rajma, broccoli, banana have received great enthusiasm, because earlier there was feeling in the area that such vegetables and fruits cannot be grown there. 27285 families are actively engaged in vegetables and fruits, taken from Biotech Park, Lucknow, IIVR, Varanasi, under supervision of Discovery Park Project. 17253 families have planted orchard, 1715 have started floriculture, 13596 families have followed Basmati line sowing pattern in cereals and pulses crop, 9197 families have started dairy program, 1240 families have started bee-keeping, 19298 families have planted jatropha plant, 23752 families have used bio-pesticide for disease insect–pest control, Food Processing Programs have been started in each block and 316 families have started fisheries after their training, first time arranged by National Bureau of Fish Genetic Resources (NBFGR), ICAR without charging any fee on special request from Discovery Park. It is also noted that there are 31000 families with less than half acre land, which could be developed only through capacity building on the basis of their education for which initiative have already been taken to identify the persons for suitable training as discussed earlier.

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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH AND YIELD OF OKRA (ABELMOSCHUS ESCULENTUS L.) CV. PUSA SAWANI

Namrata Kumari, Dharmendra Kumar Singh, Manoj Kumar Singh and Vishwanath
Department of Horticulture
KAPG College Prayagraj- 211002,(U.P.), India
Email for correspondence : namratakmald@gmail.com

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ABSTRACT

A field experiment was conducted at the Research Farm, Department of Horticulture, Kulbhaskar Ashram Post Gradute College Prayagraj UP during *kharif* season 2022 to study the "Effect of Integrated Nutrient Management on Growth and Yield of Okra (*Abelmoschus esculentus* L.)". The experiment performed in randomised block design with 3 replications consisting of 8 treatment combinations of organic manure and inorganic fertilizer to ensure their effect on okra growth and yield. The present enquiry is outlined as follows based on the results. Treatment T8 (100%RDF + Vermicompost @5t/ha + Poultry Manure @ 2t/ha + Neem Cake @ 2t/ha) affected most growth characters such as plant height(cm), number of leaves per plant, number of branches per plant, number of nodes per plant and internodal length(cm) and minimum in T1 [control :100 % RDF (100:75:75kg/ha)]. Ultimately the increased in those parameters led to the increased yield. The probable reasons for increased growth of plant may be due to the presence of readily available form of nitrogen through both inorganic and organic sources (NPK, Vermicompost, Poultry manure, Neem cake,) where in inorganic source could have exerted positive influence on extended nutrient availability to match the physiological needs of the crop since it is applied in splits, which triggered to produce elevated stature of the growth components. In addition to that integration of NPK, Vermicompost, Poultry manure, Neem cake might have resulted in beneficial influence of nitrification inhibition and amelioration of soil physical and chemical properties. Good association treatment T8 (100%RDF + Vermicompost @5t/ha + Poultry Manure @ 2t/ha + Neem Cake @ 2t/ha) also shows yield characters of number of fruit per plant, fruit length cm), fruit diameter (mm), fruit yield per plot(kg) and fruit yield per hectare (q) while minimum under T1 [control :100 % RDF (100:75:75kg/ha)].

Keywords **:** *Okra, growth, yield, organic manure and nutrients*

INTRODUCTION

The okra or lady's finger (*Abelmoschus esculentus* L.) belongs to the Family Malvaceae having somatic chromosome number of Okra 2n=130. It is native of tropical and subtropical Africa, America, Turkey and other neighboring countries besides, India. It is one of the important and popular vegetable of Uttar Pradesh. India is the largest producer of okra in the world with an annual production of 6460MT from an area at 526 lakh hectare. The major okra growing states of India are Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Karnataka and Assam. In Andhra Pradesh it

occupies of 78.90 thousand hectare with total production of 1184.2 thousand tons. Average productivity of okra in India is 11.9MT/ ha and highest productivity of okra is in Andhra Pradesh 15 tonnes per ha. (NHB 2020 – 2022). Okra is an important vegetable crop which supplies higher nutrition the green pod per 100g edible portion of okra contain moisture 89.6g, carbohyradtes 6.6g, protein1.9g, fat 0.2g, fibre1.2g, mineral0.7g, calcium 66mg , magnesium 43mg, phosphorus 56mg, potassium103 mg, vitamins-A88 IU, thiamine 0.07mg, riboflavin 0.1mg, nicotinic acid 0.6mg, vitamin –C 13MG,Oxalic acid 8mg.Okra seeds are rich in proteins, lipids and fats. The richest part of okra plants is the dried seed as it is very rich in protein, oil and antioxidant.

The mature seed are known to have superior nutritional quality which can be used for feeding children and fight against malnutrition. Okra fruit is principally consumed fresh are cooked and is a major source of vitamins A, B, C,mineral, iron and iodine and important vegetable source of viscous fiber but it reportedly low in sodium saturated and cholesterol. Singh et al., (2014). Organic manures viz. vermicompost, poultry manure and neem cake are high in organic matter and provides important nutrients.

Organic manure increases soil utility of CEC, water holding capacity and phosphates. Inorganic fertilizers such as N, P_2O_5 and K_2O are long term residual effects and fixed in soil. But now a day is expensive things and it raises agricultural costs. Second, the more use of inorganic fertilizers deteriorates the level of soil productivity daily, which immediately improves productivity but destroys the environment and harms human health.

Using organic manure in INM is therefore so important for maintain productivity. Since and improving efficiency.

MATERIALS AND METHODS

The experiment was conducted on "Effect of Integrated Nutrient Management on Growth and Yield of Okra (Abelmoschus esculentus L. Moench)" cv. Pusa Sawani carried out in *Kharif* season during the year 2022. Experimental designs was Randomized Block Design. Number of treatments were 8. Number of replications were 3.

Details of Treatment :

S.N.	Treatment Symbol	Treatment Combination
1	T_1	Control: 100% RDF (NPK)
2	T_2	100% RDF + Vermicompost @5t/ha
3	T_3	100% RDF+PoultryManure @ 2t/ha
4	T_4	100% RDF + Neem Cake @2t/ha
5	T_5	50% RDF + Vermicompost @5t/ha
6	T_6	50% RDF + PoultryManure @2t/ha
7	T_7	50% RDF + Neem Cake @2t/h
8	T_8	100%RDF+Vermicompost@5t/ha+Poultry Manure@2t/ha + Neem Cake @2t/ha

RESULTS AND DISCUSSION:

The experimental results of the present investigation have been presented and the results obtained for growth and yield parameters of different treatments have been discussed in the subsequent pages under appropriate headings.

Growth characters:

1. Plant height (cm):

The data are presented in Table 1 showed plant height (cm). There was significant difference among the treatments for plant height at different growth stages. The maximum plant height was observed in T_8 [83.01 (100% RDF+ Vermicompost @5t/ha+ Poultry Manure@2t/ha+Neem Cake @2t/ha)] followed by T_4 [76.14 (100% RDF+ Neem Cake @t/ha)], while the minimum plant height was observed in T_1 [63.25 (Control: 100% RDF)]. It has

found that the plant height was substantially increased by various coordinated nutrient control measure treatments during the growth stage. Treatments T8 was found to be substantially superior compared to T_4 and T_3 respectively. Whereas lowest was observed under T^1 (control:100%RDF) treatment. The superiority of T_8 application of RDF, Vermicompost, poultry manure and neem cake which resulted in faster plant growth. The results of this investigation concerning maximum plant height are consistent with the finding of Mal *et al*. (2013), Sharma *et al*. (2014), Yadav *et al*. (2015) previously recorded in okra.

2. Number of branches per plant:

The number of branches per plant of okra plant shown in table 1. The maximum number of branches per plant were obtained under the T_8 [4.60 (100% RDF+ Vermicompost @5t/ha+ Poultry Manure@2t/ha+Neem Cake @2t/ha)] followed by T_4 [4.18 (100% RDF+ Neem Cake @t/ha)], while the minimum number of branches per plant was observed in T_1 [2.06 (Control: 100% RDF)]. Probable reason for increased branch numbers due to higher photosynthesis rates and photosynthesis provides maximum branch growth or improvements in endogenous auxin in response to apical dominance. These finding agree with Sharma *et al*. (2014), Sachan*et al*. (2017), D C Meena and Meena*et al*. (2018), Dwivedi*et al*.(2018).

3. Number of nodes per plant and Internodal length (cm)

It was stated the mean number of nodes per plant as seen in table 1. The number of nodes per plant greatly impacted by the multiple nutrient sources. The number of nodes per plant in T_8(17.04) was significantly maximum and at par T_4(14.10) followed by T_3(13.33), T_2(12.63), T_7(11.06), T_6(10.50), T_5(9.33) while the minimum number of nodes per plant was recorded at T_1(7.00).

It was stated the mean internodal length as seen in table 1. The okra internodal length greatly impacted by the multiple nutrient sources. The internodal length in T_8 (6.40) was significantly maximum and at par T_4 (5.43) followed by T_3 (5.00), T_2 (4.83), T_7 (4.56), T_6 (4.40), T_5 (3.56) while the minimum internodal length was recorded at T_1 (3.06).

The mean number of nodes per plant and internodal length was found with T8 was significantly high above T4 and T3 respectively. In comparison minimum number of nodes per plant and internodal length observed in T 1 (control) treatment. In treatment grew more vegetative growth using RDF, Vermicompost, poultry manure and neem cake nutrient influences per plant were pursued to increase the number of nodes showing that pattern of growth in nodes was due to nitrogen absorption. This may be because the application of nitrogen via. organic and inorganic fertilizer has increased plant growth which could increase the length of internodes. These finding agree with Mal *et al*. (2013), Ghuge*et al*. (2015), Amiry*et al*. (2017), Dwivediw*et al*.(2018).

Yield Parameters:

1. Number of fruits per plant:

It mean number of fruits produced per plant as shown in table 2. The amount of fruits per plant greatly impacted by the multiple nutrient sources. The number fruits per plant in T_8(18.77) was significantly maximum and at par T_4(15.49) followed by T_3(14.98), T_2(14.60), T_7(13.62), T_6(13.23), T_5(12.72) while the minimum number fruits per plant was recorded at T_1(9.85). It mean number of fruits produced per plant as shown in table 2. The amount of fruits per plant greatly impacted by the multiple nutrient sources.

2. Fruit length (cm) and Fruit diameter (mm):

It mean fruits length as shown in table 2. The length of fruits greatly impacted by the multiple

nutrient sources. The fruit length in T_8(18.77) was significantly maximum and at par T4(1.33) followed by T_3(10.16), T_2(9.70), T_7(9.36), T_6(8.80), T_5(8.23) while the minimum fruit length was recorded at T_1(7.50).

It mean fruit diameter as shown in table 2. The diameter of fruits great impacted by the multiple nutrient sources. The fruit diameter in T_8(17.01) was significantly maximum and at par T_4(15.20) followed by T_3(14.63), T_2(14.00), T7(13.83), T_6(13.18), T_5(12.66) while the minimum fruit diameter recorded at T1(11.83).

The increased fruit lengthand fruit diameter may be due to better photosynthesis that translocation. The abundance of nutrient at the crucial stage of crop growth resulted in early development, rapid plant growth and development leading to longer and broader fruit production. These finding are also consonance Deshpande *et al*. (2003), Kumar *et al*. (2013), Mal *et al*. (2013), Sharma *et al*. (2014), Yadav *et al*. (2015), Dwivedi*et al*. (2018).

3. Fruit yield per plot (kg):

The fruit yield per plot and fruit yield per hectare as shown in table 2. The fruit yield per plot greatly impacted by the different nutrient sources. The fruit yield per plot in T_8(4.222) was significantly maximum and at par T_4(3.765) followed by T_3(3.565), T_2(3.257), T_7(3.053), T_6(2.842), T5(2.604) While the minimum fruit yield per plot recorded at T1(2.085) respectively. These results are in line with the findings of Firoz et al. (2004) in which he found that integration of organic and inorganic fertilizers application significantly increased the fruit yield over inorganic fertilizers alone and also over control.

4. Fruit yield per hectare (q):

The fruit yield per hectare in T_8(130.31) was significantly maximum and at par T_4(116.23) followed by T_3(110.05), T_2(100.54), T_7(94.23), T_6(87.72), T_5(80.49) while the minimum fruit yield per hectare recorded at T_1 (64.37) respectively. This finding agreed with Tyagi1 et al. (2016) NPK increase soil fertility and vermicompost, poultry manure and neem cake increases microbial population in the soil, due to effect of INM yield of fruits (q/ha) increases.

Table 1: Effect of Integrated Nutrient Management on Growth parameters of Okra cv. Pusa Sawani

Treat.	Plant height (cm)	No. of branches/ plant	No. of nodes / plant	Internodal length (cm)
T_1	63.25	2.06	7.00	3.06
T_2	73.16	3.46	12.63	4.83
T_3	74.78	3.77	13.33	5.00
T_4	76.14	4.18	14.10	5.43
T_5	68.14	3.02	9.33	3.56
T_6	69.57	3.08	10.50	4.40
T_7	71.08	3.27	11.06	5.56
T_8	83.01	4.60	17.04	6.40
S. E±	2.31	0.52	1.40	0.62
C.D.(5%)	7.02	1.60	4.25	1.89

Table 2: Effect of Integrated Nutrient Management on Yield parameters of Okra cv. Pusa Sawani

Treatment	No. of fruits	Fruit length (cm)	Fruit diameter (mm)	Fruit yield/plot (kg)	Fruit yield/ha (q)
T_1	9.85	7.50	11.83	2.085	64.37
T_2	14.60	9.70	14.00	3.257	100.54
T_3	14.98	10.16	14.63	3.565	110.05
T_4	15.49	11.33	15.20	3.765	116.23
T_5	12.72	8.23	12.66	2.604	80.49
T_6	13.23	8.80	13.18	2.842	87.72
T_7	13.62	9.36	13.83	3.053	94.23
T_8	18.77	14.33	17.01	4.222	130.31
S. E±	1.22	1.16	1.46	0.474	3.568
C.D.(5%)	3.71	3.53	4.45	1.439	10.824

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EFFECT OF PLANT GROWTH REGULATORS ON GROWTH AND YIELD OF BRINJAL (SOLANUM MELONGENA L.) CV. KASHI KOMAL UNDER PRAYAGRAJ CONDITION

Neeraj Kumar Patel, Manoj Kumar Singh, Dharmendra Kumar Singh and Vishwanath
Department of Horticulture
Kulbhaskar Ashram Post Graduate College Prayagraj 211002 (U.P.), India.

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ABSTRACT

The present investigation "effect of plant growth regulators on growth and yield of brinjal *(Solanum melongena L.)* cv. Kashi Komal" under Prayagraj condition was carried out at the research farm ,Department of Horticulture, Kulbhashar Ashram P.G. Collage Prayagraj during *rabi season* 2022-23. The two doses of NAA (20ppm, 40ppm) and GA_3 (25ppm, 50ppm) were sprayed at 40, 80 and 120 DAT. The single and combined application of plant growth regulators had a great influence at all the growth stages of the crop. Significance differences in all parameters like plant height(cm), number of leaves per plant, number of primary branches per plant, number of secondary branches per plant, days to 50% plant flowering, number of fruit per plant, fruit length (cm), fruit diameter (cm), fresh fruit weight (g), fruit yield per plant (Kg), fruit yield per plot (Kg) and fruit yield per hectare (q), due to single and combined application of plant growth regulators was recorded. Highest plant height (85.07 cm), highest number of leaves per plant (95.70 cm), highest number of primary branches per plant (6.90), highest number of secondary branches per plant (18.30), lowest days to 50% plant flowering (40.20), highest number of fruit per plant (42.80), highest fruit length (13.90 cm), highest fruit diameter (3.50 cm), highest fresh fruit weight (69.00 g), highest fruit yield per plant (2.90 kg), highest fruit yield per plot (26.55 kg) and highest fruit yield per hectare (655.55q) was observed in treatment T_8 (NAA @ 40 ppm + GA_3 @50 ppm) while lowest plant height (68.83 cm), lowest number of leaves per plant (75.15 cm), lowest number of primary branches per plant (3.70), lowest number of secondary branches per plant (13.20), highest days to 50% plant flowering (55.61), lowest number of fruit per plant (25.06), lowest fruit length (8.75 cm), lowest fruit diameter (1.85 cm), lowest fresh fruit weight (46.6 g), lowest fruit yield per plant (1.17 kg), lowest fruit yield per plot (10.53 kg) and lowest fruit yield per hectare (260.00 q) was observed in treatment T_0–control(Water spray).

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Keywords : *Naphthalene acetic acid and gibberellic acid, brinjal, growth and yield .*

INTRODUCTION

Brinjal *(Solanum melongena L.)* 2n= 2x= 24 belong to family solanaceae, sub-family solanoideae and tribe solane is well responsive to nutrition and to great viability with varieties , climatic condition and soil fertility. Its is one of the most common and popular vegetable crops grown extensively in India and other parts of the world. In India major brinjal producing states Orissa, Bihar, Karnataka, Tamil Nadu, West Bengal, Andhra Pradesh, Maharashtra and Uttar Pradesh.

It is one of the most important vegetable crops after Potato and Tomato. In India, brinjal is the king of vegetable and it being consumed as a cooked vegetable in many ways and is liked by both poor and rich. Year round availability, easy culture, moderate to high yield and consumption in varieties of ways like salad, bhaji, stuffed brinjal, bhartha, chatni, pickles etc.

Minerals matter, besides one hundred gram edible portion of brinjal fruit contains 92.7% moisture, 24.0% calories, 4.0% carbohydrates, 14.0 g protein, 0.3 g fats, 13 g fibers, Vitamin A (124.0 IU), carotene (34mg), riboflavin (0.05mg), thiamine (0.05mg), niacin (0.5mg) and 12.0 mg Vitamin C (Chen and Li, 1996). It also contains 52.0 mg Chlorine, 47.0 mg Phosphorus, 44.0 mg Sulphur and other Minerals (Aykroyd, 1963).

"Plant growth regulators are organic substances other than nutrient and vitamin, which in small amounts to promote, inhibit or modify any plant physiology". Plant growth regulators includes artificially produced substances as well as phytohormones . They are classified under different groups of Auxin, Gibberellins ,Cytokinins, Inhibitors and Retardants, Ethylene, and Morphactins (Gowda *et al.*,1986). Among the plant growth regulators that used in present experiment are NAA related to auxins and GA_3 related to gibberellins groups. The used of plant growth regulators as foliar spray has brought spectacular results in both growth and yield of brinjal. The effectiveness of growth regulators varies with dose and time of application in different crops. Having these ideas as a background, an attempt was made to study the effect of plant growth regulators on growth and yield parameters of brinjal cv. Kashi Komal under Prayagraj condition.

MATERIALS AND METHODS

The experiment was carried out during *Rabi* season 2022-23 at the research farm, Department of Horticulture, Kulbhaskar Ashram Post Graduate College Prayagraj 211001 (U.P.) India. The experiment consisted of two level of NAA and GA_3 and their combination in a Random Block Design (RBD) with three replication and nine treatments i.e T_0- Control (Water spray), T_1 - NAA @20ppm , T_2 - NAA @40ppm, T_3 - GA_3 @25ppm, T_4 - GA_3 @50ppm, T_5 - NAA @20ppm + GA_3 @25ppm, T_6 - NAA @20ppm + GA_3 @50ppm, T_7-NAA @40ppm + GA_3 @25ppm and T_8 - NAA @40ppm + GA_3 @50ppm.The mechanical composition, physical and chemical properties of experimental field was analyzed. The physical and chemical properties of soil such as pH (Jackson,1967), Nitrogen (Subbian and Asija, 1954,),Phosphorus (Olsen *et.al*,1954) and Potassium (Jackson,1967) contents were analyzed. The raised seed bed of 3×1.5m size was prepared and seeds were sown in 1.5 cm depth in rows spaced at 8 cm and covered with thin layer of FYM. 30 days seedling were transplanted to the trial plot. The required weight of PGRs was taken by using electronic balance and solution was prepared by dissolving 1g NAA and GA_3 in small quantity of acetone and volume was made to one liter by adding distilled water to obtain 1000 ppm stock solution.The required concentration of solution was spray at 30 and 45 days after transplanting. Spraying was done early in the morning to avoid rapid drying of the spray solution, due to evaporation. All cultural management practices including, irrigation, weeding, and other agronomical practices were done timely. Irrigation was done based on plant requirements. The data were collected from five random plants are selected from each plot to record growth and yield contributing parameters. All parameters like plant height (cm), number of leaves per plant, number of primary branches per plant, number of secondary branches per plant, days to 50% plant flowering, number of fruit per plant, fruit

length (cm), fruit diameter (cm), fresh fruit weight (g), fruit yield per plant (Kg), fruit yield per plot (Kg) and fruit yield per hectare (q) were measured. The data collected were analyzed statistically by F-test to examine the effects and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSIONS

1. Effect of plant growth regulators on growth parameters:-

The plant growth regulators significantly increased growth parameters such as plant height (cm), number of leaves per plant, number of primary branches per plant , number of secondary branches per plant and days to 50% plant flowering.

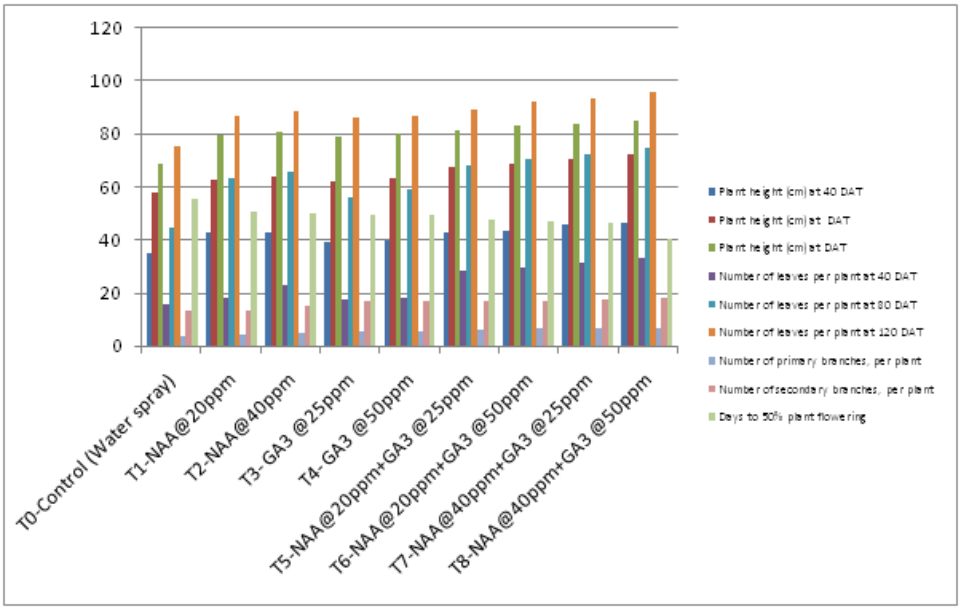
In the present investigation, data on effect of plant growth regulators on growth parameters of brinjal are furnished in (Table-1). At 40 DAT, the T_8-NAA @ 40ppm + GA_3 @50ppm significantly increased the plant height (46.30 cm), followed by T_7-NAA @ 40ppm + GA_3 @25ppm (45.70 cm) and lowest plant height (34.83 cm) recorded under T_0 - Control (Water spray). At 80 DAT, in T_8 -NAA @ 40ppm + GA_3 @50ppm highest plant height (72.22 cm), followed by T_7 -NAA @ 40ppm + GA_3 @25ppm (70.82 cm) and lowest plant height (57.83cm) recorded under T_0 - Control (Water spray). At 120 DAT, in T_8 -NAA @ 40ppm + GA_3 @50ppm highest plant height (85.07 cm), followed by T_7 -NAA @ 40ppm + GA_3 @25ppm (84.08 cm) and lowest plant height (68.83cm) recorded under T_0 - Control (Water spray). In case of number of leaves per plant was observed in all the successive growth stages such as 40, 80 and 120 DAT. At 40 DAT, in T_8 -NAA @ 40ppm + GA_3 @50ppm significantly increased the number of leaves per plant (33.31), followed by T_7 -NAA @ 40ppm + GA_3 @25ppm (31.20) and lowest number of leaves per plant (15.80) recorded under T_0- Control (Water spray). At 80 DAT, in T_8 -NAA @ 40ppm + GA_3 @50ppm highest number of leaves per plant (74.63),followed by T_7-NAA @ 40ppm + GA_3 @25ppm (72.58) and lowest number of leaves per plant (44.50) recorded under T_0- Control (Water spray). At 120 DAT, in T_8-NAA @ 40ppm + GA_3 @50ppm highest number of leaves per plant (95.70 cm), followed by T_7-NAA @ 40ppm + GA_3 @25ppm (93.43) and lowest number of leaves per plant (75.15) recorded under T_0 - Control (Water spray). In case of the number of primary branches, and number of secondary branches per plant was significantly increased under T_8 -NAA @ 40ppm + GA_3 @50ppm (6.90 and 18.30) followed by T_7 -NAA @ 40ppm + GA_3 @25ppm (6.75 and 17.20) and the lowest number of primary branches and secondary branches per plant (3.70 and 13.20) recorded under T_0- Control (Water spray) respectively. In case of the days to 50 % plant flowering was significantly influence by different level of NAA and GA_3. Under T_8-NAA @ 40ppm + GA_3 @50ppm produced significantly lowest (40.20) days to 50% plant flowering, followed by T_7-NAA @ 40ppm + GA_3 @25ppm (46.20) and the highest (56.61) days to 50% plant flowering under T_0- Control (Water spray). The enhancement in the growth parameters by NAA and GA_3 growth substance may be due to their effect on cell division and cell elongation, respiration and nucleic acid metabolism. Similar finding have been reported by Chaudhary *et al*. (2013), Mahindra *et al.* (2018), Natesh *et al.* (2015), Netam, J.L., *at el.* (2014), Janak, L.N. *at el.* (2014), Patel J. S., *at el.* (2012), Shankhwar *et al.* (2017), Tapadiya *et al*. (2018), (Tiwari *et al*. 2005).

The combination of NAA and GA_3 (NAA @40 ppm + GA_3 @50ppm) lowest days required to 50% plant flowering that means, these growth regulators, regulated the physiological and biochemical process in plant in such a way which

tended to reduce the vegetative growth and the photosynthates transmitted from vegetative parts toward the reproductive organs. Similar finding have been reported by Bhalekar *et al.* (2006), Chaudhary *et al.* (2013), Gavaskar, D. *at el.* (2004), Mahindra *et al.* (2018), Meena, S. S. *at el.* (2003)., Moniruzzaman, *at el.* (2014), , Shankhwar *et al.* (2017) and Tapadiya *et al.* (2018).

Table : 1 - Effect of plant growth regulators on growth, parameters of brinjal cv. Kashi Komal

Symbol	Treatment details	Plant height (cm)			Number of leaves per plant			Number of primary branches, per plant	Number of secondary branches, per plant	Days to 50% plant flowering
		40 DAT	80 DAT	120 DAT	40 DAT	80 DAT	120 DAT			
T0	Control (Water spray)	34.83	57.83	68.83	15.80	44.50	75.15	3.70	13.20	55.61
T1	NAA@20ppm	42.55	62.83	79.87	18.30	63.60	87.02	4.20	13.32	50.76
T2	NAA@40ppm	42.67	63.85	80.90	22.80	65.90	88.80	4.60	15.35	49.88
T3	GA_3 @25ppm	39.17	62.23	79.23	17.33	56.02	86.44	5.20	16.60	49.70
T4	GA_3 @50ppm	40.03	63.17	80.15	18.25	58.81	86.80	5.70	16.80	49.20
T5	NAA@20ppm+GA_3 @25ppm	42.85	67.25	81.33	28.40	68.30	89.10	5.8	17.00	47.80
T6	NAA@20ppm+GA_3 @50ppm	43.52	68.50	83.24	29.50	70.27	92.10	6.6	17.10	47.20
T7	NAA@40ppm+GA_3 @25ppm	45.70	70.82	84.08	31.20	72.58	93.43	6.75	17.20	46.20
T8	NAA@40ppm+GA_3 @50ppm	46.30	72.22	85.07	33.31	74.63	95.70	6.90	18.30	40.20
--		**0.807**	**0.911**	**1.025**	**0.700**	**0.881**	**0.916**	**0.185**	**0.312**	**0.856**
CD (5%)		**1.26**	**1.947**	**2.192**	**1.497**	**1.884**	**1.960**	**0.395**	**0.666**	**1.830**



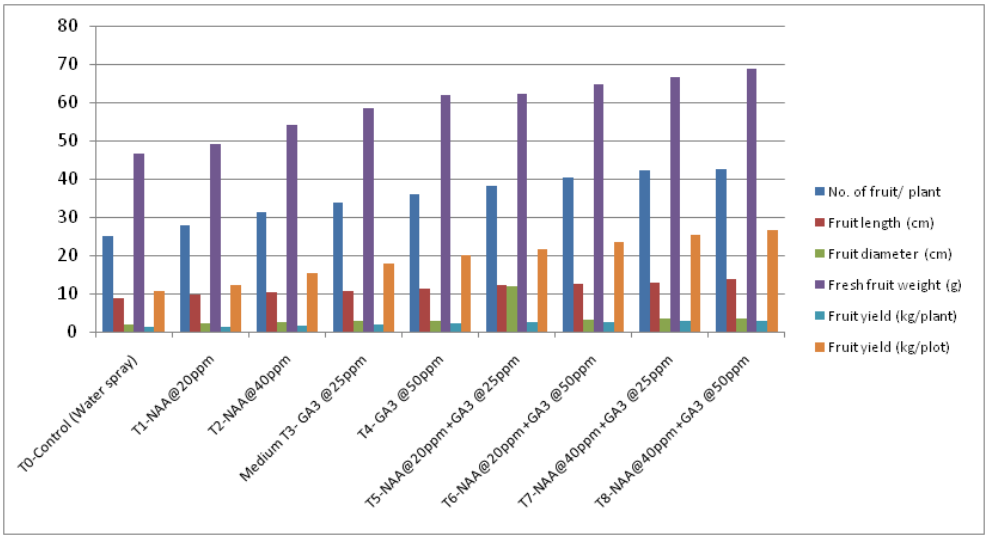
2. Effect of plant growth regulators on yield parameters of brinjal :-

The main aims of any applied research is to maximize the yield. Yield in brinjal crop is a multiplicative factor of fruit size and number of fruits, harvested from the plant.

In the present investigation, data showed (Table-2) application of different levels of plant growth regulators through foliar application has caused a significant effect on the highest number of fruits per plant was observed in T_8-NAA @ 40ppm + GA_3 @50ppm (42.80) followed by T_7 -NAA @ 40ppm + GA_3 @25ppm (42.30) and lowest number of fruits per plant (25.00) recorded under T_0- Control (Water spray). The highest fruit length was observed in T_8 -NAA @ 40ppm + GA_3 @50ppm (13.90 cm) followed by T_7 -NAA @ 40ppm + GA_3 @25ppm (12.85 cm) and lowest fruit length (8.75 cm) recorded under T_0- Control (Water spray).The highest fruits diameter was observed in T_8 -NAA @ 40ppm + GA_3 @50ppm (3.50 cm) followed by T_7 -NAA @ 40ppm + GA_3 @25ppm (3.45 cm) and lowest fruits diameter (1.85 cm) recorded under T_0- Control (Water spray).The highest fresh fruits weight was observed in T_8 -NAA @ 40ppm + GA_3 @50ppm (69.00 g) followed by T_7-NAA @ 40ppm + GA_3 @25ppm (66.70 g) and lowest fresh fruits weight (46.60 g) recorded under T_0- Control (Water spray).The highest fruit yield per plant was observed in T_8 -NAA @ 40ppm + GA_3 @50ppm (2.95 kg) followed by T_7 -NAA @ 40ppm + GA_3 @25ppm (2.82 kg) and lowest fruit yield per plant(1.17 kg) recorded under T_0- Control (Water spray). The highest fruit yield per plot was observed in T_8-NAA @ 40ppm + GA_3 @50ppm (26.55 kg) followed by T_7-NAA @ 40ppm + GA_3 @25ppm (25.38 kg) and lowest fruit yield per plot (10.53 kg) recorded under T_0- Control (Water spray) and the highest fruit yield per hectare was observed in T_8 -NAA @ 40ppm + GA_3 @50ppm (655.55 kg) followed by T_7-NAA @

Table : 2 - Effect of plant growth regulators on yield parameters of brinjal cv. Kashi Komal

Symbol	Treatment details	No. of fruit/ plant	Fruit length (cm)	Fruit diameter (cm)	Fresh fruit weight (g)	Fruit yield (kg/plant)	Fruit yield (kg/plot)	Fruit yield (q/ha.)
T_0	Control (Water spray)	25.00	8.75	1.85	46.60	1.17	10.53	260.00
T_1	NAA@20ppm	28.00	9.88	2.12	49.10	1.37	12.33	304.44
T2	NAA@40ppm	31.30	10.38	2.44	54.23	1.70	15.30	377.77
T_3	TGA^3 @25ppm	34.00	10.65	2.75	58.70	1.99	17.91	442.22
T_4	GA^3 @50ppm	36.00	11.40	2.90	62.20	2.24	20.16	497.77
T_5	NAA@20ppm+GA^3 @25ppm	38.30	12.28	3.00	62.50	2.39	21.51	531.10
T_6-	NAA@20ppm+GA^3 @50ppm	40.50	12.44	3.15	64.80	2.62	23.58	582.22
T_7	NAA@40ppm+GA^3 @25ppm	42.30	12.85	3.45	66.70	2.82	25.38	626.66
T_8	NAA@40ppm+GA^3 @50ppm	42.80	13.90	3.50	69.00	2.95	26.55	655.55
SE d ±		**0.483**	**0.382**	**0.067**	**0.673**	**0.034**	**0.305**	**7.539**
CD (5%)		**1.033**	**0.817**	**0.143**	**1.438**	**0.073**	**0.653**	**16.120**



40ppm + GA_3 @25ppm (626.66 kg) and lowest fruit yield per hectare (260.00 kg) recorded under T_0-Control (Water spray).

This might be an account of stimulating effect on root and shoot growth which might have contributed to more absorption and translocation of nutrients, played physiological role in increased photosynthesis of biomass. Yield can be considered to be the final expression of the physiological and metabolic activity of plant and is governed by the various factors like favorable physical, chemical and biological properties of soil as well as effective plant growth regulators making morphological and biochemical changes in plants. Similar finding have been reported by Bhalekar *et al.*(2006), Chaudhary *et al.* (2013), Gavaskar, D. *at el.*(2004), Janak, L.N. *at el.* (2014),Mahindra *et al.*(2018), Meena, S. S. *at el.* (2003)., Moniruzzaman, *at el.* (2014), Natesh *et al.* (2005), Netam, J.L., *at el.* (2014) , Patel J. S., *at el.* (2012), Shankhwar *et al.* (2017) and Tapadiya *et al.* (2018). ,

CONCLUSION

Plant growth regulators like NAA and GA_3 were found effective in increasing the plant growth as well as yield in brinjal at very low concentrations.

These is need to pay more attention in research work on plant growth regulators regarding brinjal crop in Prayagraj region. Plant growth regulators application is more effective in improving yield, and quality of brinjal may fetch more price and improve the economics of growers .

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EFFECTS OF GLOBAL WARMING IN INDIAN CROPS PRODUCTION

Arvind Kumar[1] and Pradeep Sirohi[2]

Department of Agronomy and Department of Agricultural Sciences

[1]Shri Karan Narendra Agriculture University, Jobner, Jaipur - 303329, (Rajasthan), India

[2]Chaudhary Charan Singh University, Meerut, (U.P.), India.

Email-arvind1266@gmail.com

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ABSTRACT

Agricultural production depends upon inputs of fertilizer, pesticides, insecticides, water which could be minimized with computerized wireless sensor network to optimize the amount of fertilizer, pesticides, insecticides, water by providing each point at required level. Similarly, there is an urgent need to replace fertilizer, pesticides, and insecticides with bio-fertilizer, bio-pesticides, and bio-insecticides as well as by developing by optimal pattern in horticulture, fruit, vegetables, animal husbandry in such a way that green house gas are minimized leading to minimal impact on climate change as well as global warming. Climate is the primary determinant of agricultural productivity. Concern over the potential effects of long-term climatic change on agriculture has motivated a substantial body of research over the past decade. This body of research addresses possible physical effects of climatic change on agriculture, such as changes in crop and livestock yields, as well as the economic consequences of these potential yield changes.

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Keywords : *Climate change, global warming, agriculture, crop cycle, greenhouse gases,*

INTRODUCTION

Climate is the primary determinant of agricultural productivity. Given the fundamental role of agriculture in human welfare, concern has been expressed by federal agencies and others regarding the potential effects of climate change on agricultural productivity. Interest in this issue has motivated a substantial body of research on climate change and agriculture over the past decade.

Climate change is expected to influence crop and livestock production, hydrologic balances, input supplies and other components of agricultural systems. However, the nature of these biophysical effects and the human responses to them are complex and uncertain. For example, crop and livestock yields are directly affected by changes in climatic factors such as temperature and precipitation and the frequency and severity of extreme events like droughts, floods, and wind storms. In addition, carbon dioxide is fundamental for plant production; rising concentrations have the potential to enhance the productivity of agro-ecosystems. Climate change may also change the types, frequencies, and intensities of various crop and livestock pests; the availability and timing of irrigation water supplies; and the severity of soil

erosion.

Agricultural systems are managed ecosystems. Thus, the human response is critical to understanding and estimating the effects of climate change on production and food supply. Agricultural systems are also dynamic; producers and consumers are continuously responding to changes in crop and livestock yields, food prices, input prices, resource availability, and technological change. Accounting for these adaptations and adjustments is difficult but necessary in order to measure accurately climate change impacts. Failure to account for human adaptations, either in the form of short-term changes in consumption and production practices or long-term technological changes, will overestimate the potential damage from climate change and underestimate its potential benefits.

Effects of climate:

- First scenario. Disregards any adjustments that farmers might make to offset the impacts of climate change on grain production, and disregard the effects on production of an atmosphere richer in CO_2. (CO_2 is essential to plant growth, and much experimental work shows that higher concentrations of it in the atmosphere in fact stimulate such growth);
- Second scenario. Incorporates the CO2 enriching effect on growth;
- Third scenario. Includes both the CO2 enriching effect and the effect of modest adjustments that farmers could make using currently known practices, for example, shifting to a different variety of the same crop and changing the planting date by less than one month in response to a change in the length of the growing season;
- Fourth scenario. Includes the CO2 effect on growth, the modest adjustments to farming just mentioned, as well as more ambitious adjustments, such as shifting to an entirely different crop, changing the planting date by more than one month, and using more irrigation.

Despite technological advances, such as improved varieties, genetically modified organisms, and irrigation systems, weather is still a key factor in agricultural productivity, as well as soil properties and natural communities. The effect of climate on agriculture is related to variabilities in local climates rather than in global climate patterns. The Earth's average surface temperature has increased by 1.5°F (0.83°C) since 1880. Consequently, agronomists consider any assessment has to be individually consider each local area.

On the other hand, agricultural trade has grown in recent years, and now provides significant amounts of food, on a national level to major importing countries, as well as comfortable income to exporting ones. The international aspect of trade and security in terms of food implies the need to also consider the effects of climate change on a global scale.

A study published in Science suggests that, due to climate change, "southern Africa could lose more than 30% of its main crop, maize, by 2030. In South Asia losses of many regional staples, such as rice, millet and maize could top 10%".[5][6]

The Intergovernmental Panel on Climate Change (IPCC) has produced several reports that have assessed the scientific literature on climate change. The IPCC Third Assessment Report, published in 2001, concluded that the poorest countries would be hardest hit, with reductions in crop yields in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect pest incidence. In Africa and Latin

America many rainfed crops are near their maximum temperature tolerance, so that yields are likely to fall sharply for even small climate changes; falls in agricultural productivity of up to 30% over the 21st century are projected. Marine life and the fishing industry will also be severely affected in some places.

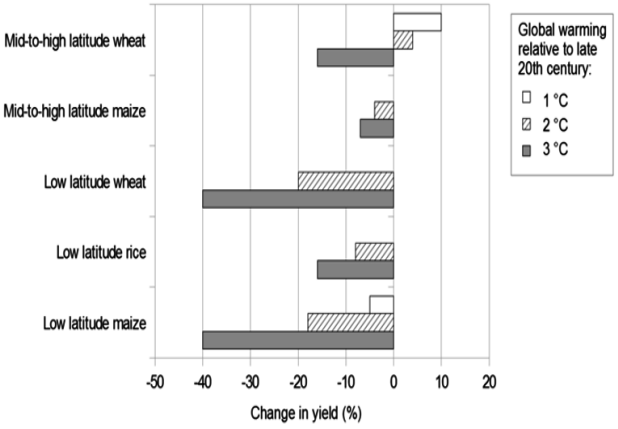
Climate change induced by increasing greenhouse gases is likely to affect crops differently from region to region. For example, average crop yield is expected to drop down to 50% in Pakistan according to the global scenario whereas corn production in Europe is expected to grow up to 25% in optimum hydrologic conditions.

More favourable effects on yield tend to depend to a large extent on realization of the potentially beneficial effects of carbon dioxide on crop growth and increase of efficiency in water use. Decrease in potential yields is likely to be caused by shortening of the growing period, decrease in water availability and poor vernalization.

In the long run, the climatic change could affect agriculture in several ways :

- *productivity,* in terms of quantity and quality of crops
- *agricultural practices,* through changes of water use (irrigation) and agricultural inputs such as herbicides, insecticides and fertilizers
- *environmental effects,* in particular in relation of frequency and intensity of soil drainage (leading to nitrogen leaching), soil erosion, reduction of crop diversity
- *rural space,* through the loss and gain of cultivated lands, land speculation, land renunciation, and hydraulic amenities.
- *adaptation, organisms* may become more or less competitive, as well as humans may develop urgency to develop more competitive organisms, such as flood resistant or salt resistant varieties of rice.

They are large uncertainties to uncover, particularly because there is lack of information on many specific local regions, and include the uncertainties on magnitude of climate change, the effects of technological changes on productivity, global food demands, and the numerous possibilities of adaptation.



Most agronomists believe that agricultural production will be mostly affected by the severity and pace of climate change, not so much by gradual trends in climate. If change is gradual, there may be enough time for biota adjustment. Rapid climate change, however, could harm agriculture in many countries, especially those that are already suffering from rather poor soil and climate conditions, because there is less time for optimum natural selection and adaption.

Observed impacts of climates

So far, the effects of regional climate change on agriculture have been relatively limited. Changes in crop phenology provide important evidence of the response to recent regional climate change. Phenology is the study of natural phenomena that recur periodically, and how these phenomena relate to climate and seasonal changes. A significant advance in phenology has been

observed for agriculture and forestry in large parts of the Northern Hemisphere.

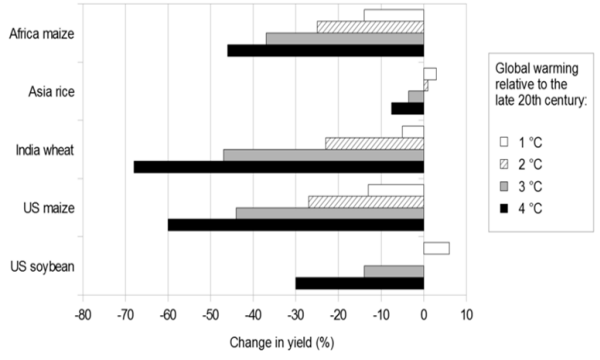
Droughts have been occurring more frequently because of global warming and they are expected to become more frequent and intense in Africa, southern Europe, the Middle East, most of the Americas, Australia, and Southeast Asia. Their impacts are aggravated because of increased water demand, population growth, urban expansion, and environmental protection efforts in many areas. Droughts result in crop failures and the loss of pasture grazing land for livestock.

Projections of agriculture

With low to medium confidence, they concluded that for about a 1 to 3 °C global mean temperature increase (by 2100, relative to the 1990–2000 average level) there would be productivity decreases for some cereals in low latitudes, and productivity increases in high latitudes. Over the same time period, with medium confidence, global production potential was projected to:

- increase up to around 3 °C,
- Very likely decrease above about 3 °C.

Most of the studies on global agriculture assessed by Schneider et al. (2007) had not incorporated a number of critical factors, including changes in extreme events, or the spread of pests and diseases. Studies had also not considered the development of specific practices or technologies to aid adaptation to climate change



Affects on agriculture due to climate:

Crop development strategy

Models for climate behavior are frequently inconclusive. In order to further study effects of global warming on agriculture, other types of models, such as crop development models, yield prediction, quantities of water or fertilizer consumed, can be used. Such models condense the knowledge accumulated of the climate, soil, and effects observed of the results of various agricultural practices. They thus could make it possible to test strategies of adaptation to modifications of the environment.

Because these models are necessarily simplifying natural conditions (often based on the assumption that weeds, disease and insect pests are controlled), it is not clear whether the results they give will have an in-field reality. However, some results are partly validated with an increasing number of experimental results.

Other models, such as insect and disease development models based on climate projections are also used (for example simulation of aphid reproduction or septoria (cereal fungal disease) development).

Scenarios are used in order to estimate climate changes effects on crop development and yield. Each scenario is defined as a set of meteorological variables, based on generally accepted projections. For example, many models are running simulations based on doubled carbon dioxide projections, temperatures raise ranging from 1 °C up to 5 °C, and with rainfall levels an increase or decrease of 20%. Other parameters may include humidity, wind, and solar activity. Scenarios of crop models are testing farm-level adaptation, such as sowing date shift, climate adapted species (vernalisation need, heat and cold resistance), irrigation and fertilizer adaptation, resistance to

disease. Most developed models are about wheat, maize, rice and soybean.

Temperature potential effect on growing period

Duration of crop growthcycles are above all, related to temperature. An increase in temperature will speed up development. In the case of an annual crop, the duration between sowing and harvesting will shorten (for example, the duration in order to harvest corn could shorten between one and four weeks). The shortening of such a cycle could have an adverse effect on productivity because senescence would occur sooner.

Effect of elevated carbon dioxide on crops

Carbon dioxide is essential to plant growth. Rising CO_2 concentration in the atmosphere can have both positive and negative consequences.

Increased CO_2 is expected to have positive physiological effects by increasing the rate of photosynthesis. Currently, the amount of carbon dioxide in the atmosphere is 380 parts per million. In comparison, the amount of oxygen is 210,000 ppm. This means that often plants may be starved of carbon dioxide as the enzyme that fixes CO_2, rubisco, also fixes oxygen in the process of photorespiration. The effects of an increase in carbon dioxide would be higher on C3 crops (such as wheat) than on C4 crops (such as maize), because the former is more susceptible to carbon dioxide shortage. Studies have shown that increased CO_2 leads to fewer stomata developing on plants[39] which leads to reduced water usage.[40] Under optimum conditions of temperature and humidity, the yield increase could reach 36%, if the levels of carbon dioxide are doubled.[citation needed]

Further, few studies have looked at the impact of elevated carbon dioxide concentrations on whole farming systems. Most models study the relationship between CO_2 and productivity in isolation from other factors associated with climate change, such as an increased frequency of extreme weather events, seasonal shifts, and so on.

Effect on quality

Moreover, the protein content of the grain decreases under combined increases of temperature and CO_2 (Ziska et al., 1997). Studies using FACE have shown that increases in CO_2 lead to decreased concentrations of micronutrients in crop plants.[43] This may have knock-on effects on other parts of ecosystems as herbivores will need to eat more food to gain the same amount of protein.

Studies have shown that higher CO_2 levels lead to reduced plant uptake of nitrogen (and a smaller number showing the same for trace elements such as zinc) resulting in crops with lower nutritional value. This would primarily impact on populations in poorer countries less able to compensate by eating more food, more varied diets, or possibly taking supplements.

Reduced nitrogen content in grazing plants has also been shown to reduce animal productivity in sheep, which depend on microbes in their gut to digest plants, which in turn depend on nitrogen intake.

Agricultural surfaces and climate changes

Climate change may increase the amount of arable land in high-latitude region by reduction of the amount of frozen lands. A 2005 study reports that temperature in Siberia has increased three degree Celsius in average since 1960 (much more than the rest of the world). However, reports about the impact of global warming on Russian agriculture indicate conflicting probable effects: while they expect a northward extension of farmable lands, they also warn of possible productivity losses and increased risk of drought.

Sea levels are expected to get up to one meter higher by 2100, though this projection is disputed. A rise in the sea level would result in an

agricultural land loss, in particular in areas such as South East Asia. Erosion, submergence of shorelines, salinity of the water table due to the increased sea levels, could mainly affect agriculture through inundation of low-lying lands.

Low lying areas such as Bangladesh, India and Vietnam will experience major loss of rice crop if sea levels rise as expected by the end of the century. Vietnam for example relies heavily on its southern tip, where the Mekong Delta lies, for rice planting. Any rise in sea level of no more than a meter will drown several km^2 of rice paddies, rendering Vietnam incapable of producing its main staple and export of rice.

Erosion and fertility

The warmer atmospheric temperatures observed over the past decades are expected to lead to a more vigorous hydrological cycle, including more extreme rainfall events. Erosion and soil degradation is more likely to occur. Soil fertility would also be affected by global warming. However, because the ratio of carbon to nitrogen is a constant, a doubling of carbon is likely to imply a higher storage of nitrogen in soils as nitrates, thus providing higher fertilizing elements for plants, providing better yields. The average needs for nitrogen could decrease, and give the opportunity of changing often costly fertilisation strategies.

Due to the extremes of climate that would result, the increase in precipitations would probably result in greater risks of erosion, whilst at the same time providing soil with better hydration, according to the intensity of the rain. The possible evolution of the organic matter in the soil is a highly contested issue: while the increase in the temperature would induce a greater rate in the production of minerals, lessening the soil organic matter content, the atmospheric CO_2 concentration would tend to increase it.

Potential effects of global climate change on pests, diseases and weeds

A very important point to consider is that weeds would undergo the same acceleration of cycle as cultivated crops, and would also benefit from carbonaceous fertilization. Since most weeds are C3 plants, they are likely to compete even more than now against C4 crops such as corn. However, on the other hand, some results make it possible to think that weedkillers could gain in effectiveness with the temperature increase.

Global warming would cause an increase in rainfall in some areas, which would lead to an increase of atmospheric humidity and the duration of the wet seasons. Combined with higher temperatures, these could favour the development of fungal diseases. Similarly, because of higher temperatures and humidity, there could be an increased pressure from insects and disease vectors.

CONCLUSION

On a global scale, the regional increases and decreases associated with climate change are note expected to result in large changes in food production over the next century. Nonetheless, impacts on regional and local food supplies in some low latitude regions could amount to large percentage changes in current production. Climate change may therefore impose significant costs on these areas. In addition, warming beyond that reflected in current studies may impose greater costs in terms of aggregate food supply. Projections from most economic studies show substantial economic losses as temperature increases beyond the equivalent of a CO_2 doubling. This reinforces the need to determine the magnitude of warming which may accompany the CO_2 buildup currently under wayin the atmosphere. Internationally, the effects of climate change on agriculture and food supply are likely to be similar to those seen in the United States.

However, other stressors such as population growth may magnify their effects. For example, in developing countries, adaptation options like changes in crop-management or ranching practices or improvements to irrigation are more limited than in the India and other developing nations.

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