Volume 7, Number 1 & 2, February & August 2012

JOURNAL OF NATURAL RESOURCE AND DEVELOPMENT

Society of Biological Sciences and Rural Development
10/96, Gola Bazar, New Jhunsi, Allahabad - 211 019 (U.P.)

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Journal of Natural Resource and Development 7(1,2):1-13, 2012

BIOLOGICAL MANAGEMENT OF WEB BLIGHT DISEASE CAUSED BY *THANATEPHORUS CUCUMERIS* = *RHIZOCTONIA SOLANI* ON URDBEAN

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ABSTRACT

Studies were conducted *in-vitro* and *in-vivo* using *Trichoderma harzianum, T. viride, T.virens, Bacillus subtilis, Glomus fasciculatum,* Neem oil seed cake and Vitavax (corboxin) against web blight disease caused by *Rhizoctonia solani* on urdbean. In *in-vitro* tests, *T. harzianum, T. viride, T. virens,* and *B. subtilis* were against *R. solani* through dual culture, volatile and non-volatile effect tests for assessing the potentiality and virulence of each antagonists. *T. harzianum* was found most effective in all 3 phases of *in-vitro* tests against *R. solani* infecting urdbean. Prior to sowing of seeds in microplots, *T. harzianum, T. viride, T. virens,* and *B. subtilis* were mass cultured on potato dextrose broth followed filtering of profusely grown mycelium through Whatmann No 412 and kept in drying under aseptic condition separately. All dried and powdered mycelium were added in 500g packet of pre-sterilized clay soil + CMC (carboxyl methyl cellulose) prior to determining of spore load in 1g powdered mycelium for making formulation of biopesticide which would carry $1x10^8$ cfu in one gram powder. In second phase of *in-vivo* experiment, prepared biopesticide of clay soil based *T. harzianum,* clay soil based *T. viride,* clay soil based *T. virens,* and clay soil based *B. subtilis* were used as seed treatment along with Vitavax while neem oil seed cake and *Glomus fasciculatum* were applied as soil treatment. Results showed significant improvement in germination, plant growth, and yield while great suppression in disease incidences caused by *R. solani* in microplot trials in Bundelkhand regions.

Key words: Biopesticide, formulations, biocontrol agents, web blight disease, VA-Mycorrhiza, neem seed cake fungicide and mungbean, rainfed)

Blackgram/Urdbean (*Vigna mungo* (L.) Hepper) is native to India and widely cultivated in the rainfed areas in various states. In Uttar Pradesh, Bundelkhand is one of the prime regions which produce urdbean on large scale. The Bundelkhand (BKD) region in the central plains of India is composed of 13 districts covering a total area of 7.08 m ha, of which six districts with 4.12 m ha area are in Madhya Pradesh (MP) and seven districts with 2.94 m ha area in Uttar Pradesh (UP). The districts are: Sagar, Damoh, Datia, Panna, Chhatarpur, and Tikamgarh in MP and Jhansi, Lalitpur, Jalaun, Hamirpur, Banda, Mahoba and Chitrakoot in UP. These districts lag behind in terms of development but hold tremendous potential for pulses in terms of area expansion and productivity improvement. Rainfed agriculture is the main livelihood occupation of the farmers in BKD region. However, BKD remains a low productivity zone compared to other parts of UP and MP. For example, yield of pulses in UP BKD is around 60% of the yield in Western UP. Even within the region, district-wise yield disparities for these crops are 3 to 6-fold. This is mainly because the majority of

farmers continue to grow local/obsolete varieties without proper inputs since they are either unaware of improved technologies or have no/limited access to quality seeds and critical inputs. Therefore, improving productivity of urdbean and reducing the existing yield gaps have direct bearing on the rural livelihood of poor farmers in the region. Among several biotic constraints of urdbean production, web blight caused by *Thanatephorus cucumeris* (Fr.) Donk (=*Rhizoctonia solani* Kühn) is a very destructive disease. It causes considerable losses in yield (Dwivedi and Saksena 1974) and considered one of the major factors for low productivity the crops (Dubey and Dwivedi 2000). *R. solani* has prolonged saprophytic survival ability (Dubey and Dwivedi 1992), wide host range (Ogoshi 1987, Carling *et al.* 1994) and causes different diseases on a wide variety of plants all over the world under diverse environmental conditions than any other plant pathogenic species (Baker 1970). Therefore, the management of the diseases caused by such seed, soil and airborne pathogen is very difficult. Presently, use of chemicals pesticide and resistant varieties are the only effective means to manage diseases caused by *R. solani* (Dubey and Dwivedi 1988, Mocioni *et al.* 2003), which are not only hazardous for human being and other organisms but also increase environmental pollutions (Chet 1993) while due to an availability of resistant varieties rate of seed replacement is about 8-10% by farmers in Bundelkhand. The presence of antifungal compounds in antagonistic microbial pesticides is well-recognized (Mahadevan 1982, Ajaiyeoba and Krebs 2003) and of considered valuable for plant disease control (Singh and Dwivedi 1987). The efficacy of fungal, bacterial, VA-Mycorrhiza, oil seed cake and fungicides have been tested against web blight causing *T. cucumeris* = *R. solani in-vitro* conditions (Kurucheve *et al*, 1997, Dubey 1998, Bhaskar *et al.* 2002)., However, attempts has not been made to evaluate them against development of web blight disease on urdbean under field conditions.

For over two decades, biocontrol research has been greatly influenced by the idea that biocontrol agents could be a potential alternative to the use of chemicals for the management of plant diseases caused by soilborne pathogens (Chet 1987, Chet 1993, Benhamou and Chet 1996, Innocenti *et al.* 2003). Considerable attention has been directed to the control of *Rhizoctonia solani* by fungal, bacterial, VA-Mycorrhiza, and organic amendments such as oil seed cakes. In particular biocontrol using *Trichoderma* species has studied since the pioneering work of Weindling and Fawcett (1936) for control of damping-off caused by *R. solani* in citrus. Trichoderma spp. attack a large variety of phytopathogenic fungi responsible for major crop diseases (Elad *et al.* 1981, Chet 1987, Papavizas 1985, Mukhopadhyay 1994, Benhamou and Chet 1996, Dubey and Dubey 2000, Antal *et al.* 2000, Tamuli and Boruah 2002, *et al.* 2003, Thornton 2004, Lu *et al.* 2004). One of the biggest obstacles in practical biocontrol is large quantities of the biogent necessary to achieve control when applied directly in the field as different bio-formulations (Adams 1990). To develop an eco-friendly and sustainable integrated management strategy for the web blight of urdbean, the authors evaluated several fungal and bacterial biocontrol agents, VA-Mycorrhiza, oil cake and fungicides in various modes of applications individually in *in-vitro* and under microplot conditions. The main objective of the present study, therefore, was to evaluate various biocontrol agents for management of web blight disease caused by *Thanatephorus cucumeris*=*R. solani* on urdbean.

MATERIALS AND METHODS

In-vitro tests

2.1 Isolation and procurement of pathogen and antagonistic bio-control agents:

During general surveys for the web blight disease on pulse crops , a large number of root-rot affected urdbean plants were encountered and later isolated and identified as *Thanatephorus cucumeris*=*R. solani* and maintained it on 4°C in lab for further use.

Trichoderma harzianum, *T. viride*, and *T. virens*; and a bacteria *Bacillus subtilis* were selected for the present study. *Trichoderma harzianum* (ITCC No.-6797) and *T. viride* (ITCC No.-2109) were procured from Indian Type Culture Collection, Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi while *T. virens* (fungus) and *B. subtilis* (bacteria) were isolated from soil adhering to the rhizosphere of healthy plant root systems grown in conducive soil. From the same soil, the antagonists were isolated using serial dilution plate techniques on selective medium-SM (Elad and Chet, 1983). This was repeated 5 times to make pure concentrations of microbes from 1 gram soil. Finally same aliquots were dissolved in 54 ml semi solid SM medium and poured into sterile petri plates and allowed grows in BOD at 25±2°C for 7 days. The isolated antagonists through several repeated sub-culturing were purified by hyphal tip or single spore methods. All fungal and bacterial antagonists were identified based on their morphological characters described by Rifai (1969). The purified and identified cultures of all fungal and bacterial antagonists were maintained on PDA by subculturing at regular intervals and stored at 4°C for maintaining their virulence and for further use.

2.3 *In-vitro* evaluation of the antagonistic fungal and bacterial biocontrol agents on urdbean:

2.3.1 Dual culture technique:

Trichoderma harzianum, *T. viride*, *T. virens*, and bacteria *Bacillus subtilis* were evaluated against *R. solani* =*Thanatephorus cucumeris* on urdbean under laboratory conditions by a dual culture technique described by Morton and Stroube (1955) to select the most potent one for further studies. Inoculation was conducted using a 5 mm diameter mycelial disc (7 days old) of pathogenic *R. solani* along with fungal and bacterial biocontrol agents on separate PDA contained in petri plates with 90 mm diameters at equal distance from the periphery. Inoculated plates were placed in an in B.O.D. incubator at 25±2°C and radial growth of *R. solani* was measured at intervals of 2, 4, 6 and 8 days after inoculation. Adequate control was maintained in which only 5 mm diameter mycelial disc *R. solani* inoculated centrally with ten replications for each treatment. Percent inhibitions of radial growth of *R. solani* were calculated using the prescribed formula.

From the zone of inhibition between the antagonistic fungal and bacterial and test pathogens *R. solani* in dual culture plate, the mycelial mats were gently lifted with a needle and put in a drop of cotton blue on a microscopic slide and spread with a needle and observed under microscope for hyphal interaction (Fig-1).

2.3.2 Effect of volatile inhibitors:

Trichoderma harzianum, *T. viride*, *T. virens*, and *Bacillus subtilis* were evaluated in laboratory for their ability to inhibit growth of pathogens by producing volatile substances following the techniques described by Dennis and Webster (1971a). *Trichoderma harzianum*, *T. viride*, *T. virens*, and *Bacillus subtilis* were centrally inoculated by placing 5 mm discs taken from 3 days old cultures, placed on PDA containing 90mm petri-dish, and incubated at 25+2°C for 3 days. The top of each petri-dish was replaced with a bottom of the 90mm diameter PDA plate inoculated centrally with a 5 mm disc of pathogenic fungus *R. solani*. Petri-dishes with PDA medium without fungal and bacterial biocontrol agents at the lower lid and inoculated with fungus *R. solani* separately maintained as controls with three 10 replications for each treatment. The pairs of each petri-disc were sealed together with paraffin tape and incubated at 25±2°C. Colony diameters were measured at 4 and 6 days after incubation, and the inhibition of mycelial growth was calculated using formula described above.

2.3.3 Effect of non-volatile inhibitors:

The effect of non-volatile substances produced by *Trichoderma harzianum*, *T. viride*, *T. virens*, and *Bacillus subtilis* were determined by following the methods of Dennis and Webster (1971b). *T. harzianum*, *T. viride*, *T. virens*, and *Bacillus subtilis* were inoculated into 100 ml sterilized potato dextrose broth in 250 ml conical flasks and incubated at 25±2°C. After 15 days, each culture was filtered through 3 folds of Whatman No. 42 filter paper, and the filtrate was collected in a pre-sterilized flask. The culture filtrate was added to molten PDA medium (at

40°C @ 12ml/120ml) to obtain a final concentration of 10% (w/v). Fifteen ml of each medium obtained from each biocontrol agents was poured into two separate petri-dishes, and after solidification, each plate inoculated with 3 mm discs of *R. solani* separately. Control plates of the pathogen *R. solani* were maintained without amending the culture filtrate of *Trichoderma harzianum*, *T. viride*, *T. virens*, and *Bacillus subtilis*. Petri-dishes were sealed with paraffin tape and incubated at 25±2°C for 6 days. Radial growth of pathogen, *R. solani* was recorded and percent inhibitions were calculated using the prescribed formula.

The percent growth inhibition was calculated by the following formula

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

I = Percent growth inhibition

C = Colony diameter of pathogen in control

T = Colony diameter/radial growth of pathogen in treatment

The percent inhibition data were transformed in $\sin^{-1}$ percentage transformation and analyzed statistically in completely randomized design (CRD).

4 Mass multiplication of *Trichoderma harzianum*, *T. viride*, *T. virens*, and *Bacillus subtilis* on suitable medium to develop an ideal biopesticide:

After above systematic *in-vitro* tests of *Trichoderma harzianum*, *T. viride*, *T. virens*, and *Bacillus subtilis* against *R. solani*, all the fungal and bacterial antagonists were selected to mass culture on suitable medium followed by developing appropriate biopesticide formulations. All fungal and bacterial antagonists were maintained on PDA tube slants at 5°C after growing for seven days at 25±2°C. Later, each biocontrol agent was separately multiplied on potato dextrose broth in 250 ml conical flasks (and incubated at 25±2°C). The mycelial mat alongwith conidia were transferred in sterile blooting paper for air drying under laminar flow after passing through 3 folds of Whatman No. 42 filter paper. The dried mycelial mat of each biocontrol agent were powdered and sieved with 80-mesh sieve under aseptic conditions. The concentration of conidia and chlamydospores were further determined using a haemocytometer prior to preparations of bio-formulations. After estimation of spore load, the fungal and bacterial antagonists were added in requisite doses to each of the pre-sterilized carriers after ensuring the spore load of each formulation as $2X10^8$ CFU/g. The formulations for each biocontrol agent in the present study with their respective constituents were:

Clay soil (CS) + CMC @ 5%w/w + *T. harzianum* at $1X10^8$ CFU/g,

Clay soil (CS) + CMC @ 5%w/w + *T. viride* at $1X10^8$ CFU/g

Clay soil (CS) + CMC @ 5%w/w + *T. virens* at $1X10^8$ CFU/g

Clay soil (CS) + CMC @ 5%w/w + *B. subtilis* at $1X10^8$ CFU/g

In the 4 carriers, carboxyl methyl cellulose @5% w/w was added as an adhesive. This was followed by sealing 500g of each bio-formulation under a laminar air flow.

2.5 *In-vivo* tests:

2.6 Microplot field trial:

The microplot experiment was conducted during the 2012 and 2013 cropping seasons at the farm of the Institute of Agriculture Sciences, Bundelkhand University Jhansi which is in the rainfed region of Bundelkhand. Each test consisted of eight treatments and 8 replications placed in completely random design. Each microplot was 4m long x 2.5m wide. Spacing between rows was 25 cm for total 10 rows and seeding was at 30 seeds per row. The experiment was conducted in a *Rhizoctonia solani* infested field developed through continuously growing of the highly susceptible urdbean variety Shekhar and inoculation with *R. solani* for more than four years. In addition to application of *T. harzianum*, *T. viride*, *T. virens*, *B. subtilis* for biological control of web blight disease caused by *R. solani*, VA-Mycorrhiza (*G. fasciculatum*), Neem oil seed cake were applied as a soil treatment 15 days before sowing mixed to 10cm upper layer while vitavax (Corboxin) as fungicide was applied as a seed treatment. *G. fasciculatum* was

procured from Division of Microbiology, Indian Agricultural Research Institute, New Delhi while Neem oil seed cake and vitavax (Corboxin) were procured from market available as commercial product. Entire treatments have been given as prescribed in following ways:

i. Clay soil (CS) based *T. harzianum* $1X10^8$ CFU/g dose@10g/kg seeds
ii. Clay soil (CS) based *T. viride* $1X10^8$ CFU/g dose@10g/kg as seed treatment
iii. Clay soil (CS) based (*T. virens*) $1X10^8$ CFU/g dose@10g/kg as seed treatment
iv. Clay soil (CS) based (*B. subtilis*) $1X10^8$ CFU/g dose@10g/kg as seed treatment
v. VA-Mycorrhiza (*Glomus fasciculatum*) dose@100spores/m² as soil treatment in Materials and Methods?
vi. Neem oil seed cake @ 200 kg ha^{-1} as soil treatment
vii. Vitavax 1g kg^{-1} as seed treatment
viii. control

Nitrogen and phosphorus @ 20 and 40 kg ha^{-1} were applied as per area specific recommendations. All cultural practices in the field were adopted as accordance to practices suggested to the farmers for urdbean production.

Observations in respect of seed germination were recorded one week after sowing. Plant height, root length and number of root nodules per plant were recorded on the basis of randomly selected 12 plants per plot. Disease incidences were recorded on the basis of random selection of 50 plants from each replication. Grain yield were also recorded at maturity and harvesting of the crops from each microplot separately. Data were statistically analyzed using M-STAT computer package for test of significance (critical differences) at 5% level (Syndocor and Cochran 1967) and the mean values of two years were presented.

RESULTS AND DISCUSSION

In-vitro tests:

3.1.1 Dual culture test:

Among the antagonists tested, *T. harzianum* showed maximum radial colony growth inhibition (41.34%) of *R. solani* at the 2nd day after incubation followed by *T. viride* (40.34%), *T. virens* and *B. subtilis* (37.50%) mentioned in Table-1. Similar trends were observed in colony growth inhibition percentages after the 4th day following incubation in which *T. harzianum* exhibited maximum radial growth inhibition (49.08%) of *R. solani* followed by *T. viride* (43.42%), *T. virens* (40.78%) and *B. subtilis* (37.17%) mentioned in Table-1. No paragraph On the 6th day after incubation, *T. harzianum produced* maximum radial growth inhibition (61.52%) of *R. solani* followed by *T. viride* (59.40%), *T. virens* (56.89%) and *B. subtilis* (54.51%) while at the 8th day after incubation, similar findings were recorded with *T. harzianum* in maximum radial growth inhibition (86.95%) of *R. solani* followed by *T. viride* (83.40%), *T. virens* (80.40%) and *B. subtilis* (78.60%) listed in (Table 1).

Microscopic observations were made of the hyphal interactions of antagonistic *T. harzianum*, *T. viride*, *T. virens* and *B. subtilis* and *R. solani*. Observations indicated that hyphae of *Trichoderma spp.* coiled around the hyphae of *R. solani* and killed or lysed them. In some situations *Trichoderma spp.* formed hook or bunch like structures around the hyphae of *R. solani* from which point penetration was initiated. Hyphae of the antagonists either coiled around the hyphae of *R. solani* and penetrated at the point of coiling or entered directly. The antagonistic mycelia of *T. harzianum*, *T. viride*, *T. virens* and *B. subtilis* overgrew on the mycelium of *R. solani*.

3.1.2 Effect of volatile compounds:

On the 4th day after incubation to test volatile compound release *T. harzianum* caused highest reduction in radial growth (32.20%) of *R. solani* followed by *T. viride* (29.17%), *T. virens* (26.38%) and *B. subtilis* (24.28%). Data from 6th day after incubation showed similar results in reduction of radial growth *R. solani* by *T. harzianum* followed by *T. viride* (45.08%), *T. virens* (42.45%) and *B. subtilis* (40.08%). On the 8th days after incubation, the highest significant reduction in radial growth of *R. solani* were observed in *T. harzianum* (61.09) followed by *T.*

Table-1 Effect of four biocontrol agents on radial growth inhibition of *R. solani* after 2, 4, 6 and 8 days of incubation.

Treatment	Radial growth inhibition (%) of *R. solani*			
	2	4	6	8
T. harzianum	41.34(40.88)	49.08(44.47)	61.52(51.66)	86.95(68.82)
T. viride	40.34(39.43)	43.42(41.22)	59.40(50.42)	83.40(65.96)
T. virens	37.50(36.77)	40.78(39.69)	56.89(48.96)	80.40(63.72)
B.subtilis	34.34(35.87)	37.17(37.56)	54.51(47.59)	78.60(62.42)
S. Em±	0.60	0.20	0.13	0.11
LSD(P=0.05)	1.86	0.63	0.41	0.35
Mean of ten replications				
Figures in parentheses are transformed angular values				

viride (58.40%), *T. virens* (56.46%) and *B. subtilis* (55.20%) mentioned in (Table 2).

3.1.3 Non volatile compounds:

The results on effect of non-volatile compounds secreted by *T. harzianum* after 8 days incubation resulted in maximum radial growth inhibition of *R. solani* followed by *T. viride* (51.0%), *T. virens* (47.67%) and *B. subtilis* (44.67%) with respect to the mycelial growth inhibition (Table-3).

3.2 Microplot experiment:

All microplots treated with clay soil based *T. harzianum* showed significantly improved germination, plant growth parameters, yield and suppression of pathogen *R. solani* as compared to the control treatment (Table 4). Generally treatments producing greatest biological activity that followed were clay soil based *T. viride*, clay soil based *T. virens*, clay soil based *B. subtilis*, Neem oil seed cake, *G.fasciculatum*, Vitavax and control.

Success of any biological disease management practice depends upon its efficacy, practicability and method of application. In addition, success of biocontrol also depend virulence of strains because it may vary according to agroclimatic conditions and

Table 2: Effect of volatile compounds released by four biocontrol agents on radial growth inhibition of *R. solani* after 4, 6 and 8 days of incubation.

Treatment	Radial growth inhibition (%) of *R. solani*		
	4	6	8
T. harzianum	32.20(34.57)	47.55(43.59)	61.09(51.41)
T. viride	29.17(33.35)	45.08(42.17)	58.40(49.83)
T. virens	26.38(30.91)	42.45(41.24)	56.46(48.72)
B.subtilis	24.28(29.52)	40.08(39.92)	55.20(47.99)
S.Em±	0.25	0.22	0.05
LSD(P=0.05)	0.76	0.84	0.38
Mean of ten replications			
Figures in parentheses are transformed angular values			

Table 3: Effect of non-volatile compounds secreted by four bio-control agents on radial growth inhibition of *R. solani* after 8 days of incubation

Treatment	Mean radial growth inhibition (%) of *R. solani* on 8 days
	8
T. harzianum	55.33(48.06)
T. viride	51.00(45.57)
T. virens	47.67(43.66)
B.subtilis	44.67(41.94)
S. Em±	0.22
LSD(P=0.05)	0.69
Mean of ten replications	
Figures in parentheses are transformed angular values	

Table 4 Effect of different treatments on seed germination (%), plant growth, disease incidences (%) and grain yield of urdbean in microplot experiment:

Treatment	Seed germination (%)	Plant height (cm)	Root length (cm)	Root nodules (no.plant^{-1})	Disease incidences (%)	*Grain yield kg ha^{-1}
T.harzianum	82.5(65.27)	29.1	7.2	11.2	9.1(17.56)	940.7(30.68)
T. viride	80.9(64.10)	28.0	6.8	9.7	12.9(21.05)	890.4(29.85)
T. virens	79.8(63.29)	27.5	6.5	8.8	11.3(19.64)	899.6(30.00)
B. subtilis	77.6(61.75)	27.1	6.8	10.0	10.5(18.91)	885.7(29.77)
G.fasciculatum	71.5(57.73)	28.6	8.3	11.0	11.2(18.5)	910.4(30.18)
Neem oil seed cake	76.5(61.0)	28.3	7.1	8.3	13.2(19.55)	865.9(29.44)
Vitavax	77.2(61.48)	28.5	6.2	7.8	10.1(18.53)	826.8(28.76)
Control	56.70(48.85)	22.7	4.8	6.85	27.60(31.69)	715.6(26.76)
SEm±	(1.1)	0.4	1.0	0.3	1.2	2.6
LSD(P=0.05)	(1.3)	1.4	1.0	1.5	1.6	3.9
Figures in parentheses are transformed angular values						
*Figures in parentheses are √(n+ 0.5) transformed values						
Mean of eight replications						

acceptability and compatibility with soil. Considering above importance of agro-climatic region, antagonistic biocontrol agents should be passes through systematic *in-vitro* screening test, prior to release as a formulated biopesticide on commercial scale. Our above *in-vitro* tests was done using antagonistic microbes against web blight disease causing *R. solani* on urdbean in 3 segments as described in details in materials and methods.

Among all tested antagonistic biocontrol agents, *T. harzianum* was found to be most effective against web blight caused by *R. solani* followed by *T. viride*, *T. virens*, *B.subtilis* compared to the control in the three test using dual culture, volatile and nonvolatile screenings. The greater efficacy of *T. harzianum* against *R. solani* may be due to its more virulent nature in interaction over the pathogens, release of strong antibiotics, enzymes (Chitinases, β-1, 3 glucanses), hormones antifungal mycotoxins.

Results of dual culture test of *T.harzianum* and *R. solani* showed maximum inhibition of *R. solani* radial growth followed by *T. viride*, *T.virens* and *B.subtilis*, and *T. harzianum* expressed more coiling and lysis of hyphae of *R. solani* as observed under microscopic study. It may attributed either due to parasitization, diffusion of volatile gases, secretion of enzymes, hormones, toxic substances or competition for food. Chet and Baker, (1981) also reported that the hyphae of the mycoparasite grow directly towards the host by a chemotropic reaction. When the mycoparasite reaches the host, its hyphae coils around it and penetrates into the host mycelium by partial degradation of its cell wall (Elad *et al.*, 1983). It appears that the main mechanism involved in the antagonism to pathogenic fungi by *Trichoderma* spp. is the release of lytic enzymes. The production of extracellular β-1, 3 glucanases, chitinases (Elad *et al.*, 1982 &1984) and protinase (Geremia *et al.*, 1993) increased significantly when *Trichoderma* was grown in the medium supplemented with either autoclaved mycelium or fungal cell walls. These enzymes play an important role in the destruction of the pathogens (Chet and Baker 1981; Hadar *et al.*, 1979). The lytic activity of several strains of *Trichoderma* spp. on cell walls of phyto-pathogenic fungi was correlated with the degree of biological control of these pathogens *in vitro* (Papavizas, 1985). Pandey and Goswami (2005) also conducted *in-vitro* and *in-vivo* experiment with different strains of *B. subtilis* against *Fusarium udum* infecting pigeonpea and found quite effective in suppressing population of above pathogen. Goswami *et al.* (2005) conducted the *in-vitro* tests of six isolates of *T. harzianum* against wilt causing *F. oxysporum* f. sp. *lycopersici* on tomato and observed similar variable inhibition response of which the one from IIHR, Bangalore showed highest inhibition of test fungus (87.22%) while least inhibition (65.27%) was observed in *T. harzianum* isolate from Shillong (Assam). Average inhibition of mycelial growth of wilt-causing pathogens was also observed in the same isolate of *T. harzianum* (Elad *et al.*, 1980; Morshed, 1985; Padmodaya and Reddy, 1996). Although, the present investigation concerning interaction between antagonistic fungi *T. harzianum*, *T. viride*, *T. virens*, and *B. subtilis* and web blight fungus *R. solani*, their correlation is showing potential variability among the isolates. It might be due to variable antagonistic nature of the respective isolates which would influence by their degree of toxic metabolites.

Trichoderma strains produce volatile toxic metabolites that impede colonization by antagonized microorganisms. Among these metabolites, the production of antibiotics, viridin, gliovirin, gliosoprenins, enzymes, hormones and some others have been described. In present investigation *T. harzianum*, *T. viride*, *T. virens*, and *B. subtilis* were screened for production of volatile compounds to inhibit to inhibit *R. solani* hyphal growth. Results expressed maximum inhibition of radial growth of *R. solani* by the production of volatile compounds with *T. harzianum* followed by *T. viride*, *T. virens* and *B. subtilis*.

Variable inhibition of radial growth of *R. solani* by *T. harzianum*, *T. viride*, *T. virens B. subtilis* may be due to differential production of volatile compounds by *T. harzianum*, *T. viride*, *T. virens* and *B. subtilis*. The differential toxic nature of volatile compounds may be explained due to unequal inhibition capacity of the

pathogens. *T. harzianum*, *T. viride*, *T. virens* and *B. subtilis* have been found effective and inhibited maximum growth of *R. solani* by the production of volatile compounds (Pandey and Upadhyay, 1997; Kumar and Dubey, 2001). The volatile compounds produced by *T. viride* proved inhibitory against *R. solani* (Padmodaya and Reddy, 1996), *Fusarium oxysporum* f. sp. *sesami* (Karunanithi and Usman, 1999), *Dematophora necatrix* (Tapwal *et al.* 2004).

Productions of non-volatile compounds are one of the key characteristic of the *T. harzianum*, *T. viride*, *T.virens*, and *B.subtilis*. *T. harzianum* inhibited maximum significant radial growth inhibition of *R. solani* by the secreting of non-volatile toxic compounds in culture filtrates at the 8th day of incubation followed by *T.viride*, *T.virens*, and *B.subtilis*. This showed that maximum toxic non-volatile substances produced by *T. harzianum* are more officious than others for inhibiting growth of *R. solani*. Upadhyay and Mukhopadhyay (1983) reported the growth inhibition of *Sclerotium rolfsii* through the non-volatile substances produced by *T. harzianum* isolates. Similarly, Pandey and Upadhyay (1997) reported on non-volatile effect on *F. udum* produced by *T. harzianum*. *T. harzianum* was observed as the best antagonists against *Fusarium solani* f. sp. *pisi* causing collar rot on pea by release of non-volatile substances.

The success of a bio-control agent also depends upon its ability to remain viable in formulation, to produce

Fig 1 mycoparasitism of *T.harzianum* on *R.solani*

inoculum in large quantities and to survive, grow and proliferate well around the rhizo-sphere of the growing plants. Such types of antagonistic establishment of an ideal substrate during seed, seedling and soil treatment is likely to provide a better and rich food base to antagonist for better proliferation. The use of microbial biomass such as alginate priUs and granules, starch granules (Lewis *et. al.*, 1995), wheat bran alginate pellet, pyrax (Lewis and Fravel, 1996), talc powder (Sankar and Jeyrajan, 1996) extruded granules and cellulose granules have been successfully used against soil-borne plant patho-gens as seed, seedling and soil treatment on various crops. Prasad and Rangeshwaran (1999) observed significant reduction in the incidence of chickpea damping-off (*R. solani*) by the application of modified granular formulation containing powder wheat bran, Kaolin, acacia powder and biomass of *T. harzianum*, *T. viride* and *Glocladium deliquescens*. They further (2000) observed that after 30 days of storage the population of the antagonist in formulation declined, but retained substantial number of viable propagules even at 90 days. Various formulations of antagonists have been developed and tried by workers (Shanker and Jayarajan, 1996; Vidhyasekaran *et al.*, 1997; Sen, 2000; Tewari and Mukhopadhyay, 2001, Pandey *et. al.* 2011), however, their efficacies and shelf life varied in each formulation and area from where antagonists were isolated. In the present study, soil application of clay soil based *T. harzianum* induced maximum seed germination of urdbean under *R. solani* infested soil, but overall performance of soil application of neem oil seed cake was better than other treatments used in these tests. The superiority of soil application of Neem oil seed cake over the *T. harzianum*, *T. viride*, *T. virens*, *B. subtilis*, *G fasciculatum* and vitavax in seed and soil treatment mode of application was probably due to improvement in physiochemical properties of the soil and supply of some additional nutrients for plant growth, and in addition, is known for its multifarious action viz. fungicidal, nematicidal, insecticidal properties.

Rapid colonization and greater protection provided to the germinating seeds by *T. harzianum*,

T. viride, *T. virens*, *B. subtilis*, and *G fasciculatum* might be the reason for superiority over the vitavax seed treatment. In several cases, integration of biocontrol agents *T. harzianum*, *T. viride*, *T. virens*, *B. subtilis*, and *G fasciculatum* in combination with other compatible treatments were found superior over any one treatment alone due to synergistic effects and variation in the mode of action of the fungicide and biocontrol agents. Integration of *G fasciculatum* alongwith neem oil seed cake provide high rate of proliferation of *G fasciculatum* population because of neem oil seed cake supplying valuable nutritive material. *G fasciculatum* is not only known to suppress the harmful micro-flora, it is also makes plants more tolerant by supplying a wide range of macro and micronutrient from soil (Goswami *et al.* 2007). Consistent chemical pesticides in soil are known to destroy biodiversity of pathogens as well as beneficial soil microflora and are therefore better control by biological means (Henis *et al.* 1978, Henis and Papavizas 1982, Hwang and Chakravorty 1993). In addition, due to the nature of competition, *Trichoderma* multiplies and colonize on dead mycelium of kind of host pathogen including *R. solani*. The present findings are also supported by other workers that the bioagent, neem oil seed cake and fungicide provided significantly higher disease control in several crops than that obtained by either any one alone (Mukhopadhyaya 1994, Dubey 2000, Kumar and Dubey 2001). These treatments could be important components of organic farming for urdbean.

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Journal of Natural Resource and Development 7(1,2):14-17, 2012

STUDIES ON EFFICACY OF HANPV WITH PLANT EXTRACTS IN THE MANAGEMENT OF *HELICOVERPA ARMIGERA* (HUBNER)

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ABSTRACT

Results on evaluation of HANPV at 250 LE per ha in combination with different plant extracts under field condition against Helicoverpa armigera on cabbage indicated that highest percent (81.66%) larval reduction was recorded in the HANPV + NSKE – 5% followed by HANPV+neem oil-0.1% (73.33%). The other botanicals like mustered oil -0.2% chilli garlic extract-2.5%, Soobabul leaf extract -2% and Pongamia leaf extract-2% alongh with HANPV recorded 62.78, 60.26, 55.38 & 53.75 percent larval reduction, respectively over control (5.53%) after first spray. Least percent larval reduction was observed in sole treatment of HANPV with 45.60 %. The same trend was observed after second Spray. The addition of NSKE 5% or neem oil-0.1% with HANPV spray solution sowed additive effect and also avoided deterioration of NPV in the sun light and helps in bringing more reduction in the larva population of H. armigera immediately after each spray.

***Key words** : NSKE Plant extracts. Helicoverpa armigera, HANPV.*

Among different insect pests infesting cabbage, tobacco caterpillar, Helicoverpa armigera is very important polyphagus pests distributed throughout the world (Chari and Patel 1983) The stock of H. armigera seems to have developed resistance to some of the common insecticides like Carbaryl, endosulfon and mono crotophos (Ramakrishnan et al. 1983). The development of resistance to the effective chemicals prompted the scientific community to look for alternative methods of management of insect pests. Under these circumstances utilization of natural pathogens may prove worthy for control of tobacco caterpillar. Among various bioagents used against this rest, NPV has been most extensively studied for its virulence (Foxa and Richter 1992), pathogenicity, mass production, safety, and field efficacy in controlling H. amigera on cabbage, groundnut, sunflower, tobacco (Jayaraj et a. 1999). However, the slow speed of action against target insects represents another serious disadvantage of NPVs as efficient insecticides, allowing the pests to infest the crops for consideration periods of time. Hence, knowledge of the effectiveness when combined with other adjuvants especially plant based extracts is very much needed. To increase the efficacy of NPV, certain adjuvansts have been used which increase adhesiveness, wettability, stability and suspensibility and act as gustatory stimulants (Rabindra and Jayaraj, 1988 and Bijjur et al. 1991).

Several plant products have potent biological activities and are capable of causing developmental abnormalities in insects. However quite a few studies on compatibility of plant products with NPV against H. armigera have been under taken. So in present investigations different plant products were mixed with HANPV sprays to improve virulence of virus against H. armigera on cabbage.

MATERIALS AND METHODS

The experiments was conducted to test the performance of plant products with HANPV at the Department of Horticulture K.A.P.G.College, 2012. The plot size was 3 x 2.4 m^2 with 60 cm and 45 cm spacing. One-month-old seedlings of cabbage variety

Pusa Drum Head were transplanted in the field and recommended agronomical practices were followed. The investigation comprise of eight treatment viz., T_1 :HANPV +neem oil – 0.1%, T_2: HANPV + Mustard oil-0.2% T_3 :HANPV + Chilli garlic extract-2.5% T_4: HANPV+ soobabool leaf extract-2% and T_5: HANPV + Pongamia + soobabool leaf extract -2% and T_6 : sole treatment of HANPV and T_8 : untreated check. The HANPV @250 LE per hectare was taken in all the treatments ,different adjuvants prepared in the laboratory at desired concentration were added to HANPV spray suspension, Jaggery (0.5%) was used as phagostimulant and teepol (0.1%) used as surfactant. The treatments were replicated thrice in Randomized Block Design (RBD). Spraying was scheduled in two times in a growing period and spraying was done using high volume of knapsack sprayer @ the recommended dosage of 500 ml/ha containing 250 larval equivalent (LE) of NPV (one LE = 6×10^9 POB_{s}. The first spray was given 45 days after transplanting and the second spray after a fortnight interval. Five plants were randomly selected from each plot to record the observation on larval mortality. The pre-treatment and post treatment larval counts were recorded 24 hours before and 3, 5, and 7 days after each spraying, respectively.

The data regarding larval population and yield were subjected to analysis of variance. Cost benefit ration (CBR) was also worked out as per the method described by (B) Nagrare and More, 1998.

RESULTS AND DISUSSION

All the treatments were significantly superior over control (Table 1). The maximum larval morality (81.66%) was recorded in the treatment at HANPV + NSKE- 5% followed by HANPV + Neem oil-0.1% (73.3. %) at 7 days after first spraying. The next effective treatments were HANPV + Chill garlic extract-2.5% and HANPV + mustard oil-2% recorded 62.78% and 60.26 percent larval reduction and were found to be on par with each other. The treatment of Sobabool leaf extracts -2% and Pongamia leaf -2% were found superior over control in reducing larval population up to 55.38 and 53.75 per cent. The least larval reduction was observed in sole treatment of HANPV (45.60%) and it was on par to that of sobabool leaf extract -2% and Pongamia leaf extract – 2%.

Similar type of trend of results were also recorde during second spray, where highest mortality of H. armigera recorded in NSKE-5% treatment i.a. 83.33% followed by Neem oil-o.1% (72.28%). Among the different HANPV and botanical combinations, HANPV + NSKE (5%) was the best treatment in reducing larval population during spray intervals, which recorded larval reduction in the range of 58.06% to 81.66% after first spray, 56.27 to 83.33% after second spray. NSKE being antifeedant enforced the larvae for repeated nibbling of foliage in search of palatable food there by increasing the ingestion of virus, which might have resulted increased susceptibility of lavae to the virus. The present findings were in accordance with findings of Patil (1993), Sarode et al , (1995), Gopali (1998) and Patil (2000). HANPV + Neem oil (0.1%) and HANPV + chilli garlic extract (2.5%) were the next best treatments which recorded significantly higher per cent larval reduction over sole treatment of HANPV\. The improved efficacy of NPV with neem oil was in conformity with Muthiah (1998), Sireesha and Kulkarni (2001), Shapiro et al, (2009).
Even though Mustard oil, soobabool leaf extract and pongamia leaf extract performed remarkably well during different spray intervals, their efficacy was on par with sole treatment of HANPV. Results of study are in line with Sireesha and Kulkarni (2001). Patil (2000) reported that pongamia leaf extract failed to increase the efficacy of HANPV in ground nut ecosystem.

Economics of the treatment

The net return was highest in HANPV + NSKE – 5% (Rs 26,449/ha). It was followed by T1 sand T2 with net returns of Rs 25,172 and 23,706, respectively. In these treatments IB: C ratio was 13.15, respectively (Table-2) , for every one rupee invested for management of H. armigera. The highest incremental benefit cost ratio of 14.08 was recorded

Table 1: Efficacy of HANPV with plant extracts against *Helicoverpa armigera* under field condition.

Treatments	First spray				Second Spray			
	Pre-treatment Count/ Plant	Cumulative per cent larval Reduction over control			Pre-treatment Count/ Plant	Cumulative per cent larval Reduction over contol		
		3DAS	5DAS	7DAS		3DAS	5DAS	7DAS
T1:HANPV +Neem oil (0.1%)	3.30	51.88 (46.06)	64.57 (53.55)	78.33 (58.90)	3.26	51.65 (46.94)	69.45 (56.56)	76.28 (61.22
T2:HANPV+ Mustard Oil(0.2%)	3.27	43.06 (39.82)	57.06 (49.47)	62.78 (52.46)	3.30	43.06 (39.82)	55.47 (48.24)	59.06 (49.86)
T3:HANPV+NSKE(5%)	3.33	58.06 (49.66)	74.29 (59.63)	81.66 (64.65)	3.33	56.27 (48.61)	71.08 (57.62)	83.33 (65.90)
T4:HANPV+Chilli Garlic Extract (2.5%)	3.26	42.66 (40.74)	59.06 (49.86)	60.26 (50.92)	3.27	40.93 (39.74)	49.33 (44.61)	58.73 (50.02)
T5:HANPV+Calotropis Leaf Extract(2%)	3.27	43.18 (41.00)	45.58 (42.43)	55.38 (48.08)	3.23	38.26 (36.94)	45.74 (42.53)	55.47 (48.16)
T6:HANPV+Pongamia Leaf Extract(2%)	3.13	37.97 (38.01)	49.35 (44.61)	53.75 (47.15)	3.33	34.26 (36.15)	45.58 (42.43)	49.35 (44.61)
T7:HANPV alone	3.23	32.26 (36.26)	43.16 (41.010)	45.60 (42.40)	3.13	30.67 (33.98)	37.97 (38.01)	43.33 (41.15)
T8: Untreated Control	3.40	0.00 (2.86)	4.70 (12.46)	5.53 (13.56)	3.47	0.00 (2.86)	4.70 (12.46)	0.00 (2.86)
S.Ed(±)	NA	4.02	4.17	4.30	NA	3.84	4.05	4.33
CD@0.5	NA	7.03	7.29	7.53	NA	5.32	7.10	7.58

Table 2: Influence of application of HANPV alone and in combination with Plant products on yield and cost benefit ratio

Sl. No.	Treatments	Yield (kg/ha)	Percent Increased Yield over control	Cost of pest control (Rs/ha)	Gross return/ Profit (Rs/ha)	Net return/y rofit (Rs/ha)	CB Ratio
T1	HANPV +Neem oil (0.1%)	13972	48.08	2050	83832	25172	13.27
T2	HANPV+ Mustard Oil(0.2%)	13711	45.32	1950	82266	23706	13.15
T3	HANPV+NSKE(5%)	14189	50.38	2025	85134	26449	14.08
T4	HANPV+Chilli Garlic Extract (2.5%)	13617	44.32	1825	81702	23267	13.74
T5	HANPV+Sobabool Leaf Extract (2%)	12801	35.67	1700	76806	18496	11.88
T6	HANPV+Pongamia Leaf Extract (2%)	12625	34.88	1700	75750	17440	11.25
T7	HANPV alone	11726	31.75	1700	70356	12046	8.08
T8	Untreated Control	9435	-	-	56610	-	-

in case of HANPV + NSKE – 5%, the least cost benefit ratio (8.08%) was recorded in case of T,: HANPV alone. Even though same cost of control of T5, T6 and T7 the benefit : cost ration of T5 and T6 was higher than T7 Therefore, the cost is an important factor in the choice of treatment.

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Journal of Natural Resource and Development 7(1,2):18-23, 2012

STUDIES ON CHEMICAL REGULATION OF VIGOUR INDEX, MORPHO-PHYSIOLOGICAL AND QUANTITATIVE CHARACTERS BY SEED TREATMENT IN MUNGBEAN (*VIGNA RADIATA* (L) WILCZEK)

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ABSTRACT

An experiment was conducted during Kharif season 2012-13 at the research farm and research laboratory of Institute of Agricultural sciences, Singhaniya University, Jhunjhunu, Rajasthan, to find out the effect of different levels of growth regulator on germination percent and seed vigour and other characters of Pant mung-5, K-851 and Pusa-9072 varieties of *Vigna radiata* L. The different levels of growth regulators viz., Tap water, IBA 100ppm and GA_3 100ppm, gave significantly higher seed germination percent and vigour percent over control. Almost similar results were obtained in case of germination percent, shoot length, root length, seedling dry weight, vigour index, chlorophyll-a, chlorophyll-b and proline content. The application of growth regulator GA_3 100ppm in variety Garima was the best combination for getting higher germination percent and vigour with better seed growth.

***Key words -:** growth regulator, germination percent and seed vigour.*

India is the largest pulses producing nation in the world. Pulses are mainly grown in rainfed area. Mung bean (*Vigna radiata* L.) is considered as one of the most important pulse crop in India. It is important legume crop characterized by a relative high content of protein (22%) and short summer season crop. It is one of the important pulses crops cultivated in India ranking third having about 70% of the world area and 45% of production. In India area occupied by mung bean is about 3 million hectare with total production of 1.1 million tones but average productivity (3.20 q/ha) is quite low. Amongst the various application of optimum quantity of growth regulators has an important role in getting high germination and vigour percent in mung bean Mohammad and Muhammad, (2007) and Singh et al., (1994) under Rajasthan conditions no research work has been done to find out the proper doze of growth regulator application for getting high germination and vigour in mung bean keeping in view the above facts the present study was under taken to find out the effect of application of growth regulator on germination, vigour and other characters in different varieties of mung bean viz.- Pant mung-5, K-851 and Pusa-9072 in the Agro-climatic conditions of Jhunjhunnu region, Rajasthan.

METHODS AND MATERIALS

The field experiment and laboratory experiment was conducted at the Agricultural research farm and laboratory of Agriculture institute of Singhania university, Rajasthan during Kharif season, 2012-13. The treatments were comprised of four doses of growth regulators viz., tap water, IBA 100ppm and GA_3 100ppm with control and three varieties of mung bean, viz., Pant mung-5, K-851 and Pusa-9072 and the experimental design used was factorial central randomized block with three replications. Urea was the source of nitrogen and the source of sulphur was gypsum while triple super-phosphate was used as

source of phosphorus. Observations were recorded on germination and vigour, shoot length, root length, seed length dry weight, chlorophyll-a, chlorophyll-b and proline content. The subjected was to statistical analysis as per method proposed by Panse and Sukhatme, (1973).

RESULTS AND DISCUSSION

The results obtained in the present study are discussed characters-wise.

Germination percent :

The results presented in Table-1 showed that priming with growth regulators viz., IBA and GA_3 in 100ppm concentration for 04 h significantly improved the germination percent over tab water priming and untreated control. All the three varieties differed significantly from each other. The growth hormone GA_3 showed maximum germination (97.85) followed by IBA and tap water. These findings are in coensonance with the reports of Haleem and Mohammad, (2007) and Afzal et al., (2002) among all the three varieties of mung bean increase in seed germination with all the doses of growth regulators against control. The highest seed germination was recorded in K-851 (100.0) followed by Pant mung-5 (99.96) and the lowest seed germination (96.94) were recorded in Pusa-9072. The germination percent of increase was higher with GA_3 followed by IBA and tap water. Similar findings were reported by Posmyk and Jahan, (2007) and Young et al., (2001) who reported that the growth regulator GA_3 gave highest seed germination as compared to other growth treatments.

Shoot length :

Shoot Length recorded in three varieties of mung bean viz., Pant mung-5, K-851 and Pusa-9072 and three doses of growth regulator over control are given in Table-1, which revealed that two varieties i.e. K-851 and Pusa-9072 gave significantly higher shoot length as compared to variety Pant mung-5. The highest shoot length (27.92) was recorded in mung bean variety Pusa-9072 in compared to K-851 and Pant mung-5 but the lowest shoot length (22.06) was recorded in case of variety, Pant mung-5. These findings are consonance with the reports of Young et al., (2001). In case of priming of seed with growth regulators, GA_3 priming was observed to be significantly better over control as well as other two doses (tap water and IBA 100ppm) of growth regulators in shoot length in mung bean. But the application growth regulator at the rate of IBA and tap water was also significantly differed with each other in producing shoot length. Similar results were reported by Haleem and Mohammad, (2007) and Afzal et al., (2002) who found the application of growth regulators in mung bean was beneficial as it increased the shoot length according to GA_3 priming, IBA and tap water.

Root length :

It was revealed from Table-1 that all the three varieties of mung bean had significant effect on the root length. The highest root length was recorded (24.82 cm.) in Pusa-9072 variety. This was significantly higher in comparison to the root length in Pant mung-5 and K-851. However, non-significant difference was observed between the heights of plant length of Pant mung-5 and K-851. The effect of different doses of growth regulators on root length was evident from the fact that the root length in different doses varied considerably. All the three doses of growth regulators (tap water, IBA 100ppm and GA_3 100ppm) had significantly high effect of root length in comparison to control this could be due to faster cell divisation and menstematic activity due to availability GA_3 and IBA mixture. These results are in agreement with the findings of Hakim and Hamda, (2001) and Afzal et al., (2005) who reported that increasing levels of GA_3 priming increased the relative growth rate and asseveration rate at all the stages of crop growth.

Seedling dry weight :

The results concerning seedling dry weight in three varieties of mung bean and growth regulators, presented in Table-1 reveled that maximum seedling

Table 1 : Effect of growth regulators priming on seed germination, shoot length, root length, seedling dry weight and some other traits in Mung bean.

Treatments	Germination %	Mean	Shoot length (cm)	Mean	Root length (cm)	mean	Seedling dry weight (g)	mean
	Variety – Pant Mung-5							
T_0 -Control	85.09	87.76	19.80	22.76	15.96	18.34	0.158	0.190
T_1 -Tap water	91.09	92.74	22.06	24.72	17.38	18.99	0.172	0.221
T_2 . IBA 100ppm	96.33	96.55	23.15	25.33	17.48	21.05	0.200	0.243
T_3-GA_3 100ppm	99.96	97.86	23.79	26.00	18.88	21.73	0.230	0.267
Mean	**92.66**		**22.17**		**17.40**		**0.189**	
CD at 5%	**V=2.70**		**V=1.83**		**V=1.46**		**V=0.04**	
Treatments	**Variety – K-851**							
T_0 -Control	87.32	87.76	23.61	22.76	18.86	18.34	0.221	0.190
T_1 - Tap water	96.08	92.74	26.08	24.72	18.88	18.99	0.280	0.221
T_2 . IBA 100ppm	100.0	96.55	26.38	25.33	22.06	21.05	0.291	0.243
T_3-GA_3 100ppm	100.0	97.86	27.30	26.00	22.48	21.73	0.319	0.267
Mean	**95.99**		**25.88**		**20.58**		**0.276**	
CD at 5%	**T=4.84**		**T=1.93**		**T=2.51**		**T=0.032**	
Treatments	**Variety – Pusa-9072**							
T_0 -Control	90.33	87.76	24.92	22.76	21.15	18.34	0.199	0.190
T_1 -Tap water	90.01	92.74	26.13	24.72	21.80	18.99	0.214	0.221
T_2 . IBA 100ppm	93.13	96.55	27.45	25.33	24.60	21.05	0.238	0.243
T_3-GA_3 100ppm	96.94	97.86	27.96	26.00	24.82	21.73	0.258	0.267
Mean	**92.57**		**27.12**		**22.11**		**0.237**	
CD at 5%	**VxT=6.77**		**VxT=2.70**		**VxT=3.52**		**VxT=0.043**	

Table-2 Effect of varying levels of growth regulators priming on vigour index, chlorophyll-a, chlorophyll-b, proline content and some other traits in Mung bean.

Treatments	Vigour index	Mean	Chlorophyll-a (mg/lit.)	Mean	Chlorophyll-b (mg/lit.)	Mean	Proline content	Mean
	Variety – Pant Mung-5							
T_0-Control	14.30	16.39	0.513	0.388	0.146	0.207	133	171.00
T_1-Tap water	14.70	18.58	0.593	0.471	0.158	0.311	142	180.66
T_2-IBA 100ppm	19.99	23.11	0.852	0.605	0.277	0.463	176	228.01
T_3-GA_3 100ppm	21.58	23.99	0.808	0.577	0.240	0.392	269	268.66
Mean	18.35		0.71		0.199		172	
CD at 5%	-		V=0.261		V=0.133		V=68.09	
Treatments	Variety – K-851							
T_0-Control	21.22	16.39	0.223	0.388	0.232	0.207	290	171.00
T_1-Tap water	23.2	18.58	0.297	0.471	0.488	0.311	312	180.66
T_2-IBA 100ppm	25.2	23.11	0.354	0.605	0.67	0.463	409	228.01
T_3-GA_3 100ppm	25.4	23.99	0.317	0.577	0.549	0.392	455	268.66
Mean	24.75		0.296		0.484		363.51	
CD at 5%	-		T=0.11		T=0.11		T=44.6	
Treatments	Variety – Pusa-9072							
T_0-Control	14.63	16.39	0.48	0.388	0.255	0.207	94	171.00
T_1-Tap water	14.87	18.58	0.60	0.471	0.308	0.311	100	180.66
T_2-IBA 100ppm	22.27	23.11	0.632	0.605	0.55	0.463	106	228.01
T_3-GA_3 100ppm	26.98	23.99	0.611	0.577	0.389	0.392	114	268.66
Mean	18.96		0.559		0.346		100.26	
CD at 5%	-		VxT=0.154		VxT=0.156		VxT=61.22	

dry weight (0.319 gm.) in plant was recorded in variety K-851, which was significantly superior in comparison to other two varieties, Pant mung-5 and Pusa-9072. The differenced in seedlings dry weight between Pant mung-5 and Pusa-9072 was significantly due to application of different doses of growth regulators viz.- tap water, IBA 100ppm and GA_3 100ppm, which produced higher seedling dry weight than control. The seedling dry weight recorded in three doses of growth regulators (Tap water, IBA 100ppm and GA_3 100ppm) was significantly different from each other and GA_3 priming gave highest dry seedling weight which was followed by tap water and IBA 100ppm. These results are in conformity with the findings of Hakim Hamda, (2001) and Miyoshi and Sato, (1997) who also reported increase in seedling dry weight with increase in doses of treatments.

Vigour index :

The data given in Table-2 revealed that among all the three varieties of mung bean, variety Pusa-9072gave significantly higher vigour index (26.98) as compared to Pant mung-5 and K-851, however, lowest vigour index (21.58) was recorded in variety Pant mung-5. The data also revealed that all the three doses of growth regulator gave significantly higher vigour index as compared to control. The use of GA_3 priming gave significantly higher vigour index (26.98) over other two doses i.e. tap water and IBA 100ppm. The differences in the vigour index between GA_3 100ppm, tap water and IBA 100ppm was non-significant. The value of vigour index in control was significantly low as compared to the vigour index value of all the other three doses of growth regulator. Similar result were reported by Muhammad and Eui, (2007) and Moradi and Younesi, (2009) who observed that vigour index, germination, seedling dry weight, increased significantly with increase in doses of treatments.

Chlorophyll-a content :

Chlorophyll – a content of mungbean in three varieties i.e. Pant mung-5, K-851 and Pusa-9072 was significantly different among all the varieties Table-2 variety Pant mung-5 had highest chlorophyll – a (0.852) followed by K-851 and Pusa-9072. Application of growth regulator, IBA 100ppm was significantly better over control and produced chlorophyll – a (0.852). However, chlorophyll – a recorded with the application of tap water and GA_3 100ppm remained at par. This significant influence of different doses of growth regulators over the lower levels may be because of prolonged formations. These results are in full agreement with those observed by Sing et al., (1994), Afzal et al., (2005) who observed that the increasing levels of growth regulator not only increased the chlorophyll – a but also gave higher chlorophyll – b, more prolin content, more leaf area index and higher net assimilation rate at all the stages of crop growth.

Chlorophyll – b content :

It was observed that there was significant increase in chlorophyll – b with increase doses of growth regulator against control. All the three varieties differed significantly from each other. The highest chlorophyll – b Table-2 was recorded in K-851 (0.549) followed by Pusa-9072 (0.389) and the lowest chlorophyll – b (0.272) was recorded in Pant mung-5. These findings are in consonance with the reports of Singh et al., (1994) and Afzal et al., (2005). In case of growth regulators, maximum chlorophyll – b (0.465) was recorded with the application of IBA 100ppm priming, which was significantly higher than all other three levels of growth regulator. Similar findings were reported by Roy et al., (1995), who reported that treatment doses of IBA priming gave highest chlorophyll – b as compared to other treatments.

Proline content :

The proline content is most important traits in mung bean seeds for obtained good grain yield is given in Table-2 indicated that proline content of different varieties was significantly different from each other. The highest proline content was recorded in variety K-851 followed by Pant mung-5 and Pusa-9072.

However, significantly lower proline content was recorded in (94) in variety Pusa-9072 in comparison to K-851 and Pant mung-5 at both the stages. However, varieties K-851 and Pant mung-5 had most at par proline content study as (455 & 249) respectively. the differences in the mean value of proline content with the use of various levels of growth treatments were significantly higher in comparison to control Muhammad and Eui, (2007). The highest proline content was recorded in GA_3 100ppm followed by IBA 100ppm and Tap water. These results conform the findings of Hakim and Hamda, (2001), while going though the results obtained in this study of it was observed that proline content and proper application of growth treatments it is important attributes for getting high grain yield in mung bean.

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Journal of Natural Resource and Development 7(1,2):24-29, 2012

DELINEATION AND MAPPING OF GEOMORPHIC FEATURES IN A PART OF SULTANPUR DISTRICT (U.P) USING IRS P6 LISS- III DATA

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ABSTRACT

The present paper is an attempt to delineate and map out the geomorphic features in Gauriganj block (lies between 26°7'5"N to26°19'5"N latitudes and 81°36'45"E to81° 45'18"E longitudes; area-207.56 Km2) of Sultanpur district, Uttar Pradesh using Remote Sensing and Geographic Information System (GIS). Satellite data of IRS P6, LISS III,2009 was processed in Arc view 3.2a GIS software using Systematic Visual Image Processing Approach for generating maps of geomorphic features . The interpreted data is validated through selective field checks. The various geomorphic features in the study area recognized are Old Flood Plain, Back swamp and Palaeochannel /Abandoned channels. This study demonstrated that validated remote Sensing data and GIS techniques are efficient and adequate tools for identification and mapping of geomorphic features. The delineated geomorphic features can be utilized for evaluation and management of land resources and geo-environment on sustainable basis in the study area.

***Key Words**: Geomorphic features, remote Sensing and geographic information system, Satellite data, Arc view 3.2a GIS software, Systematic Visual Image Processing Approach, selective field checks.*

The delineation and mapping of geomorphic features is of immense help in the field of soil science, geography, hydrology and environmental engineering applications. Geomorphic features are manifestation of underlying parent materials and the nature and duration of geomorphic processes that have produced the associated geomorphic units. They leave their distinct imprint in the form of various litho-terrain characteristics and presented basic platform for different human activities and largely controlled their performance. Agricultural activities are primarily dependent on nature of surface materials as well as on the availability of water. The soil moisture holding capacity is also governed with the nature of soil and topography. The geomorphic features with the other geomorphic factors play a vital role in demarcation of soil characteristics and its productive capacity (Mishra & Choubey ,1999) . It is also very useful in evaluation and management of land resources, environmental planning and development activities (Cook and Doornkamp,1974; Panizza, 1978; Demek, 1982). Geomorphic mapping involves the identification and characterization of the fundamental units of landscape.

The modern Geo-spatial technology of Remote Sensing coupled with Geographic Information System has become the most efficient tool for geomorphological studies. One of the most important distinguishing characteristics of RS, relative to other data acquisition approaches, is that it can provide detailed, quantitative land surface information at large spatial coverage and at frequent temporal intervals (Prenzel 2004). The geomorphic features have specific set of charecteristics that determine its image signature. The remote sensing data due to its perspective view, multi-spectral, multi-resolution and frequent monitoring

capabilities make its well-suited for monitoring geomorphic conditions over any large areas. Geomorphic and geologic studies using remote sensing data are largely being done both at national and international platform. Mention may be made for the works of Way (1978) , Townshend (1981) , Barrett and Curtis (1982), Curran (1985), van Zuidam and van Zuidam(1985), Sabins (1987), Lillesand and Kiefer (1987) , Daymond, *et al.*, (1995), Lo'pez-Blanco and Villers (1995), Walsh, *et al.*, (1998), Novak and Soulakellis (2000), Bocco , *et al.*, (2001). In view of these facts, present paper is an attempt to delineate and map out the geomorphic features through processing IRS P6 LISS IV data of 2009 in the core of GIS environment for Gauriganj block, Sultanpur district(Uttar Pradesh, India). The results of the study can be utilized for evaluation and management of land resources and geo-environment on sustainable basis in the study area.

MATERIALS AND METHODS

Study area:

The study area has been undertaken in Gauriganj block (falls between latitude 26°7' 5"to 26° 10' 5" N and longitude 81° 36'45" to 81° 45' 18" E) of Sultanpur district which lies in the middle Ganga plain in the eastern part of the Uttar Pradesh, India. It covers an area of 207.56 km^2, characterized by an even and featureless plain, composed of deep and fertile alluvium deposited by the Ganga river and its tributaries. The area enjoys the typical tropical, semiarid, monsoonic type of climate characterized by a dry and hot spring/early summer, a hot rainy season, a warm autumn and a cool winter (Mishra and Sharma, 2003). The average annual rainfall is 977 mm, mainly received between July and September. The winter rains are irregular and scanty. The mean maximum and minimum annual temperatures are 47.5° C and 4.1°C, respectively. The soils of the study area have been classified as Aquic Petrocalcic Natrustalf (Soil Survey Staff, 1994) and represent a large area of man induced salt affected lands occurring in the Ganga alluvial plains.

Database:

In the present study, satellite data of IRS-P6 LISS III (path-101 and row-53, Band- Green, Red, NIR and SWIR ,Resolution-23.5 M, January, 2009) was used for mapping. The Google Earth high resolution images (source- http //www. google earth.com) and field check data (collected through field in the month of January, 2009) were used for generated map validation. The Survey of India Topographical sheets numbered 63 F (1:250000), 63 F/11, 63 F/12, and 63 F/ 16, 1974, were used for geo-referencing, basic geographical background and base map preparation. The digital image processing software ERDAS IMAGINE Version 9.1 and GIS package of Arc View, Version 3.2a were used for data analysis and mapping. The GPS map 70 Cx (Garmin Tiwan) handset was used to find latitude and longitude of ground validation points.

Methodology:

The methodology essentially is based on on-screen interpretation using standard image interpretation keys like tone, texture, size, pattern, association etc. In on-screen visual interpretation the imagery is displayed onto a computer screen (normally as FCC) and intended classes are delineated based on image interpretation elements, ancillary and legacy data. To delineate specific classes, other band combinations may also be used where the signature of particular process is quite evident. Resultant output from this will be vector format, which supports complex GIS analysis and has smaller file size. By virtue of several advantages of on-screen visual interpretation approach as given below, visual interpretation approach has been envisaged in this research work. Following methodological steps were adopted in the present study:

1.IRS P6 LISS III data set was imported in digital image processing software ERDAS IMAGINE 9.1 (Leica Geosystems ,Atlana,U.S.A.) to create a False Colour Composite (FCC) through layer stack option in image interpretation tool box. The image was geometrically corrected through image to image registration by taking various ground control points

(GCPs). The common ground control points (GCP^s) on the topographic map and image ware identified to register the image at accuracy of less than 0.2 pixels using a second order polynomial transformation .The images were resampled using the nearest neighbor interpolation and assigned polyconic projection, spheroid and Everest datum for standard geographic latitude and longitude coordinated system.

2. The study area was extracted through the subset of area of interest. The FCC was generated for the study area through layer stack option in Image Interpreter tool box.

3. To improve the appearance of the image for visual interpretation of geomorphic features the image was processed in ERDAS Imagine software. The contrast enhancement,spatial filtaring , edge enhancement and band ratioing were performed for this purpose.

4. The detection and delineation of different geomorphic features were performed employing on-the-screen visual image interpretation in ARC VIEW 3.2a software. The standard FCC images of the study area was annotated for identification and delineation of geomorphic features with the help of toposheets. A general traversing of the area was undertaken and some observations were recorded at few places. A legend was formed to identify the tonal behavior of major geomorphic features types of the imagery. The tone and texture of features types were recorded. Based on the image characteristics and tonal behavior, the image was visually interpreted on computer screen for identification of geomorphic features and the tentative map of was prepared for the study area on 1:30,000 scale. The geo-technical elements such as land use/ land cover, ground water conditions, soil and vegetation cover were also considered in visual image processing.

5. The ground truth were collected from selected sample ground points through field visit in months of November (2011) for validating interpreted information on satellite images. The Garmin GPS map 76 Cx, (Garmin Taiwan) was used during field work for locating field check points.

6. A final correlation was established by incorporating the finding of ground truth validation analysis, and a final maps of the geomorphic features was prepared.

7. In order to evaluate accuracy of interpreted both maps, randomly sampled 120 points on reference image were selected and analyzed in ERADAS IMAGINE software using Accuracy Assessment option in the Classification dialog. The classified layers were compared with ground truth data and Google earth high resolution image (source- http //www. Google earth.com) and an error matrix was prepared. The final geomorphic feature map was analyzed in ARC View 3.2a software to calculate area and statistics.

RESULTS AND DISCUSSION

Spatial Distribution of Geomorphic Features:

In the study area, three geomorphic land forms/features i.e. i. Old Flood Plain ii. Back swamp and iii. Palaeochannel /Abandoned channels were mapped using visual image processing approach. Visual image processing method gave good results for mapping geomorphic features. The geomorphic features map obtained from the satellite data is shown in Fig-1, and relevant statistics are given in Table 1. The accuracy analysis of interpreted information reveals that the average accuracy, overall accuracy, and the Kappa coefficient values for sampled sites were 90.14 per cent, 96.72 per cent and 0.945 respectively for the generated map. The description of each geomorphic units and landforms are as follows:-

i.Older Alluvial Plain : Very extensive, relatively smooth, flat to gently sloping and slightly undulating terrain characterized by deposits of unconsolidated material deposited by Ganga and Ghaghara rivers and reworked by Gomti river. On the satellite data, the old flood plain was mapped on 180.07 sq.km (86.76% of the total geographical area). The older alluvial plain of Sultanpur district occurs at 96 to 100 meter above msl and covers almost entire district. These deposits of early cycle of fluvial deposits

marked by polycyclic multiple sequence of grey sand to yellow silt and clay with intermittent calcareous horizons are characterized by occurrence of old meander, back swamp and number of palaeochannels. Older alluvial plains are also present very good to good shallow groundwater prospects.

ii. Back Swamp :- The back swamp was identified on 2.28(1.10%) sq.km area in the block. Back swamp areas typically have low relief formed on back of natural levee on either side or on both side of river channel. Natural levee obstruct the natural drainage of the area and this results in swampy conditions. During floods when water spills over natural levee form shallow pond and finer material gets deposited here depending upon distance from active channel. These finer material form impervious layer which does not allow water to percolate down and water remain there throughout the year.Most of the back swamps preserved in Gauriganj block are associated to palaeochannels of older alluvial plain.

iii. Palaeochannel/Abandoned channels:- The abandoned channel/ Palaeochannel was identified on 25.13 (12.11 %) sq.km area in the block. It is a

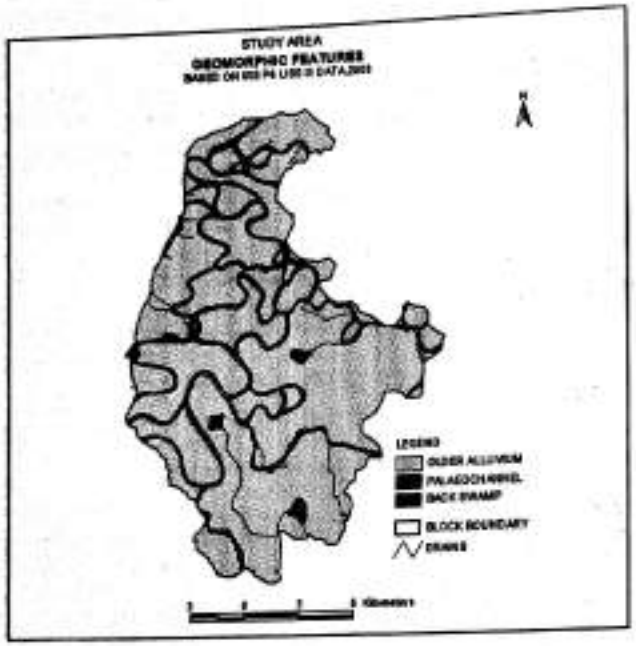

Fig-1

Table 1 : Geomorphic Features in Gauriganj Block ,Sultanpur District (U.P)

(Based on IRS P6,LISS III data,2009)

Sl.No	Landform /feature	Area (in sq km.)	Area (as % to total area)
1	Old Flood Plain	180.07	86.76
2	Back swamp	2.28	1.10
3	Abandoned channel/ Palaeochannel	25.13	12.11
	Total area	**207.56**	**100**

geomorphological expression of an abandoned river channel which is caused either human or natural factor.

These channel not only manifest the development fluvial environment but also store great amount of underground fresh water . Apart from this palaeochannel also serve as recharge zone for groundwater and act as shallow aquifers in alluvial terrain. Therefore, palaeochannels have great significance in shallow groundwater prospects.

The management of land resources calls for a periodic inventory of these resources with the emergent technology of remote sensing and subsequent improvement in sensor resolution, it has now been possible to achieve micro level planning with more than 90% accuracy in terms of land resource information. The orbiting satellite with fast repeativity cycles have made it possible to map of land resources like hydrogeomorphology, geology, drainage, forest and green biomass assessment etc. with high accuracy and in real time mode. The geomorphic features mapping of a particular area will certainly play a key role in micro level planning thereby strengthening the decision at macro and micro level. Keeping the above mentioned facts into consideration, a geomorphic inventory was made for Gauriganj block of Sultanpur district (U.P). IRS-P6 LISS-III satellite data of year 2009 was visually analysed, based on standard image characteristics, coupled with ground truth information, in order to prepare the desired geomorphic maps. This study demonstrated that validated remote Sensing data and GIS techniques are efficient and adequate tools for identification and mapping of geomorphic features .The delineated geomorphic features can be utilized for evaluation and management of land resources and geo-environment on sustainable basis in the study area.

ACKNOWLEDGEMENT

Author is grateful to Indian Council of Social Science Research (ICSSR), New Delhi for financial support to carry out the work.

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Journal of Natural Resource and Development 7(1,2):30-34, 2012

EVALUATION OF CHICKPEA (*CICER ARIETINUM* L.) GROWTH, SEED YIELD AND SEED QUALITY UNDER VARIOUS LEVELS OF NITROGEN FERTILIZATION IN BUNDELKHAND REGION

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ABSTRACT

A field experiment was conducted during Rabi season of the year 2010-11, at Agricultural farm Bundelkhand university, Jhansi (UP) study of the effect of different fertilization levels viz. 0, 15, 30 kg nitrogen/ha on seed yield and quality of chickpea cv.Pusa-261. The experiment was laid-out in randomized block design having three nitrogen fertilization levels combination with three replication. The growth parameters of chickpea i.e. plant height, branching plant^{-1}, number of leaves plant^{-1}, number of pods^{-1}, dry weight (g), and 100 seed weight was recorded higher of, 30 kg nitrogen per hectare as compare to other two doses i.e. 0 and 15 kg nitrogen per hectare whereas the minimum growth of chickpea was recorded of zero kilogram nitrogen per hectare. The maximum seed yield and protein content was recorded under 30 kg nitrogen per hectare followed by 0 and 15 kg nitrogen per hectare respectively.

***Keywords** : Growth, seed yield and quality of chickpea.*

Indian is the largest pulses producing nation in the world. Pulses are mainly grown in rainfed area. India has 35 percent of the world area and 21.2 per cent of production of chickpea (*Cicer arietinum* L.) and is most important species growth almost all over India for pulses as compared to all other species of family *legminaceae*. It is grown over an area of 6.9264 million hectares and produces 6.33 million tonnes in 2011-12. It is generally cultivated on marginal and light texture soils having limited moisture. Amongst the various agronomic factor known to augment crop production. The application of nitrogen have an important role in getting high seed yield of chickpea Barbar *et al.*, (1990), keeping in view the above facts the present study was under taken to find out the effect of application of nitrogen on seed yield, seed yield per plant and other characters including protein content and its quality in a national varieties 'Pusa-261' of chickpea in the agro-climatic condition of Bundelkhand region of U.P.

MATERIALS AND METHODS

The field experiment was conducted at the agricultural research farm of agriculture institute of Bundelkhand university, Jhansi during Rabi season 2010-11. The fertilizer treatments were comprised three levels of nitrogen viz. 0, 15, and 30 kg/ha and the experimental design used was factorial randomized block with three replication. Urea was the source of nitrogen, observation were recorded on plant height, branching per plant, number leaves and pods per plant , 100 seed weight (g), seed yield (kg/ha), seed yield per plant, protein content and harvest index. The data was subjected to statistical analysis as per method proposed by Cochran and Cox (1959).

RESULTS AND DISCUSSION

For the use of proper quantity of fertilizers is most essential for enhancing yield and quality in various crops. In case of chickpea, the nitrogen is the most important inputs for increasing productivity of this

crop. Therefore these fertilizers were tried to find their role in chickpea crop and the results of present study are discussed character wise.

Plant height :

Fertilization of chickpea plant with nitrogen Table-1 reveals an affect up to a greater extent with the increase in the rate of doses. After 60 days of sowing the plant height increased significantly up to 30 kg N/ha level, showing the maximum height of (38.989cm.) at the 120 days, the maximum plant height was recorded (69.550)cm, at 30 kg of nitrogen supply. Thus sowing clear cut effect of increase nitrogen level on plant growth, these findings are in consonance with the reports of Mukesh kumar (2006), which differed significantly from the plant height recorded at 0 and 15 kg/ha nitrogen doses (64.050 and 68.718 cm) respectively. Consequently, the main effect of nitrogen on plant height during the observation recorded after 60 days of sowing and at 120 days were found significant. The increase in plant height may be attributed mainly due to the fact the nitrogen application improved the nutritional environment & hence could result in more nutrient uptake. These findings are comparable with Pata *et al.*, (2005), who stated that plant height, number of branches increased significantly with the increasing levels of nitrogen fertilizers.

Branching :

It is revealed from Table-1 that different nitrogen levels had highly significant effect on the number of branches per plant (60 days and 120 days). The number of branches (at 60 days) was recorded 14.990 at 30 kg N/ha supply, with the application of different levels of nitrogen similar trend of significantly increase was observed for number of branches (at 120 days) per plant, their number varying from 13.948 to 17.980 with highest in case of 120 kg N/ha. This could be on account of vigorous vegetative growth due to greater cell division and more meristematic activity increasing supply of photospothates for the formation of branches. It is well known that nitrogen being the constituent of amino acids, protein, chlorophyll & protoplast would directly influence the growth & attributing characteristics through better utilization of photo synthesis. These results are in agreement with those obtained by Soltani *et al.*, (2006).

Number of leaves :

The number of leaves per plant of chickpea under three studied nitrogen fertilization rates as shown in Table-1 showed significant increased with the increased in rate of nitrogenous fertilizers. In 60 days the nitrogen application @ 30 Kg/ha produced significantly greater number of leaves (61.398) followed by 0 kg N/ha dose (55.70). However in case of 120 days of nitrogen the highest number of leaves was found (63.250) at 30 kg N/ha level, while lowest value of (56.708) in case of control. The results are quite in line with the early research work done by Chandawat *et al.*, (1976) who has reported that the increasing level of nitrogen increased plant height, number of leaves, number of branches, yield straw and leaf area index, relative growth rate and net assimilation rate at all the stages of crop growth.

Number of pods per plant :

The result presented in Table-1 indicated that all the two levels of nitrogen i.e. 15 and 30 kg N/ha gave significantly higher number of pods per plant in comparison to 0 kg N/ha. The differences in the number of pods per plant with the doses of 15 and 30 Kg N/ha were also significant. The highest number of pods per plant was recorded in 30 kg N/ha (42.32) followed by 15 Kg N/ha (35.42). These findings are in consonance to result reported by Waggan *et al.*, (2003). The successive increase in the number of pods per plant under varied doses of nitrogen may be due to availability of more nutrients for proper growth of plants at different stages of chickpea crop. These findings are in full agreement to the results reported earlier by Mukesh kumar (2006) and Waggan *et al.*, (2003).

Dry weight (g) :

Concerning dry weight under the studied nitrogen rates, data of Table-2 revealed that as nitrogen

Table-1: Individuals effect of different levels and sources of nitrogen on chickpea (*Cicer arietinum* L.)

Treatment	Plant height		Branches		No. of leaves		pods / plant
N level kg/ha	60 days	120 days	60 days	120 days	60 days	120 days	
N_0	34.300	64.050	11.590	13.948	55.70	56.708	35.42
N_{15}	38.148	68.718	14.200	16.720	59.90	60.920	39.53
N_{30}	38.898	69.550	14.990	17.980	61.398	63.250	42.32
SEM±	0.652	1.266	0.210	0.274	1.206	1.120	0.759
CD at 5%	1.328	2.580	0.428	0.559	0.559	2.281	1.54
Mean	37.110	67.43	13.593	16.216	58.999	60.293	39.09

Table-2 : Dry weight (g), seed yield/plant, seed yield kg/ha and some other quality trades as influenced by varying levels of Nitrogen fertilization.

Treatment / N level kg/ha	Dry weight (g)	Seed yield / plant (g)	Seed yield kg/ha	100 seed weight (g)	Harvest index	Protein content
N_0	12.55	10.30	1815	27.09	14.98	19.98
N_{15}	15.94	13.64	1905	28.50	14.62	23.84
N_{30}	17.70	15.09	1950	29.39	15.09	24.02
SEM±	0.288	0.252	39.079	0.490	0.38	0.95
CD at 5%	0.586	0.514	79.599	0.999	0.79	0.94
Mean	15.20	13.01	1890.00	27.99	---	22.61

rates increased, dry weight increased. Application of nitrogen upto 30 kg N/ha recorded significantly higher dry weight than that of 0 kg N/ha, although dry weight with the application of 15 Kg N/ha remained at par with 30 kg N/ha, the highest (17.70g) being recorded at 30 Kg N/ha level. Henceforth, improvement in the growth and yield attributes of Indian chickpea due to nitrogen application was quite logical. The results are in conformity with the findings of Bala *et al.*, (1994). Highest number of branches produced with the increase in nitrogen fertilization. Contributed more to the total dry weight per plant. Accordingly, increase in dry weight could be ascribed to the overall improvement in plant growth, vigour and production of sufficient photosynthetic with nitrogen fertilization.

Seed yield per plant

As for the seed yield per plant, the height value of (15.09 g) was obtained at 30 kg N/ha level showing a significant increase with the increasing dose of nitrogenous fertilizers. The various yields attributes like higher seed weight per plant and higher 100-seed weight showed their additive effect in influencing the seed yield with increasing rate of nitrogen fertilization. Ultimately all these yield attributes had their pronounced effect in significantly increasing the seed yield of chickpea at higher rates of nitrogen application upto 30 Kg N/ha. These results are in accordance with the early research workers working on *Cicer arietinum* L. Bhattarcharya andAli, (2002). Pata *et al*., (2005) and Waggan *et al*., (2003), who also reported increased yield with increased fertilization of nitrogen, data presented in Table-2 showed that the highest seed yield per plant (15.09g) was obtained under 30 kg N/ha level and lowest seed yield per plant was obtained under 0 kg N/ha level. Thus, the seed yield per plant increased significantly with a successive increase in levels of nitrogen fertilization, the reason being, seed yield of chickpea is chiefly a product of yield attributing characters like 100 seed weight etc. consequently, the increase in other yield attributing characters due to nitrogen fertilization resulted in increased seed yield per plant of chickpea. These results confirm the finding of Singh *et al., (2003).*

Seed yield :

It is observed that there was remarkable increase in seed yield with increase in the doses of nitrogen against control. The highest seed yield was recorded with the application of 30 kg /ha (1950 kg/ ha) followed by application of 0 kg (1815 kg/ha) and 15 kg (1205 kg/ha) nitrogen per hectare Table-2. The increase in seed yield under all the two doses of nitrogen was significantly higher as compared to 0 kg of N/ha. The results are in conformity with the findings of Bhattarcharya and Ali.(2002), who reported that the treatment doses of 45 kg N/ha were observe highest seed yield as compare to other treatments. Thus, the seed yield kg/ha increased significantly with a successive increase in levels of nitrogen fertilization. The reason being, seed yield of chickpea is chiefly a product of yield attributing characters like seed weight per plant etc. consequently, the increase in other yield attributing characters due to nitrogen fertilization resulted in increased seed yield kg/ha of chickpea. These results confirm the findings of Chandawat *et al*., (1976).

100 seed weight :

It is revealed from the data in Table-2 that different levels of nitrogen had considerable effect on 100 seed weight. The highest 100 seed weight (29.39g) was recorded in 30 kg N/ha which was significantly higher than the 100 seed weight in other levels of nitrogen including 0 kg N/ha (29.09 g). This could be due to the availability of more nutrients for proper development of vegetative parts of plants including 100 seed weight under higher dose of nitrogen. These results are in full agreement with those observed by Barber *et al*., (1990), who observed that the increasing levels of nitrogen not only increased the 100 seed weight but also gave higher yield of straw, more lead area index, high growth rate and higher net assimilation rate at all the stage of crop growth.

Harvest index :

The data given in Table-2 revealed that all the two levels of nitrogen gave significantly higher harvest index as compared to zero level of nitrogen. The use of 30 kg N/ha (15.09) have significantly higher harvest index over one doses i.e. 15 kg N/ha (14.98). The differences in harvest index between 0 kg N/ha and 15 kg N/ha was non-significant. Similar result was reported by Hooda *et al*., (1986) who stated that harvest index. Dry weight and protein content increased significantly with the increasing level of nitrogen fertilizers.

Protein content :

The protein content are most important quality traits in chickpea it was note from the data given in Table-2 that protein content increased successively upto application of 30 kg N/ha. The difference in the mean value of the quality traits with the use of various

levels of nitrogen application was significantly higher (24.02%) in comparison to 0 kg of nitrogen (19.98%) was non-significant. It was interesting to note from the data Table-2 that the application of 15 and 30 kg N/ha also improved the protein content by a significant margin as compared to other levels of nitrogen fertilizers. The results are in conformity with the findings of Bala *et al*.,(1994).

CONCLUSION

The findings of present study clearly indicate role of proper variety and fertilizer levels for getting higher yield in chickpea. Variety Pusa – 261 gave better yield in that order use of 30 kg N/ha give higher seed yield was the best then all other two levels of nitrogen for achieving better growth, high seed productivity and better quality under agro-ecological conditions of Bundelkhand reasons of U.P.

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Journal of Natural Resource and Development 7(1):35-39, 2012

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, YIELD AND QUALITY OF CUCUMBER (*CUCUMIS SATIVUS* L.) CV STRAIGHT EIGHT.

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ABSTRACT

An experiment was carried out at during two seasons i.e., summer 2010 and rabi 2011 to study the effect of integrated nutrient management on growth, yield and quality attributes of cucumber (cv. Straight eight) grown under open condition. The results revealed that application of 75% RDF+75% FYM+ Azotobacter+Phosphobacteria+Trichoderma (T_7) was significantly superior for growth parameters like maximum vine length (250.33,-255.16cm), number of leaves (93.26;96.50) and number of branches per plant (7.23;7.78) and yield parameters like number of fruits per vine (9.60;11.66), maximum fruit weight (270.20;349.97g), fruit yield per vine (2.42;2.45kg) and fruit yield (62.76;68 t ha^{-1}) and quality parameters like ascorbic acid content (6.5;5.91mg/100g), TSS (3.00;3.16° Brix), moisture content (95.50;96.06%) and shelf life (7.18;86 days) during summer and rabi season respectively.

Keywords: *Growth, yield, cucumber, IHM*

Cucumber (*Cucumis sativus* L.) is popular vegetable belongs to the family cucurbitaceae. It is preferably grown for its edible tender fruits in almost all parts of the world. In India, cucumber is cultivated in an area of 18,000 hectares with a production of 1,20,000 tonnes. Application of heavy doses of chemical fertilizers without organic manures or bio-fertilizers causes deterioration of soil health in terms of physical and chemical, properties of soil, declining of soil microbial activities, reduction in soil humus, increased pollution of soil, water and air. Hence, integrated nutrient management is the need of the hour. There is a need to standardize the integrated nutrient management practices for cucumber growing under field conditions to increase productivity under Indian conditions.

MATERIALS AND METHODS

The experiment was carried out the department of Horticulture K.A. P.G. College Allahabad during summer 2010 and rabi 2011 The soil of the experimental field was sandy loam having 6.5 to 7.0 pH and the plot size of 2.25x1.0 m with a spacing 1x.5cm experiment was laid out in Randomized Completerly Block Design with three replications involving 12 treatments viz., 100% recommended dose of fertilizer (80:50:90 NPK ha^{-1} +100% FYM (20t a^{-1}) (T_1); 75% RDF+ 75% FYM+ Azotobacter (AZT)+ Phosphobacteria (PSB)+ Trichoderma (TD) (T_2); 50% RDF+50% FYM+ Azotobacter+Phosphobacteria+Trichaoderms (T_3); 75% RDF + VC (1.5t ha^{-1}) + Azotobacter + Phosphobacteria +Trichaoderma (T_4); 50% RDF + VC (1.5t ha^{-1}) + Azotobacter + Phosphobacteria + Trichaoderma (T_5); 75%; RDF + 50% FYM + VC (1.5t h^{a-1}) + Azotobacter + Phosphaobacteria + Trichaoderma (T_6); 50% RDF + 50 FYM + VC (1.5t ha^{-1}) + Azotobacter + Phosphobacteria + Trichaoderma (T_7); 75% RDF+50% FYM + Azotobacter Trichaoderma (T_8); 50% RDF + 50 FYM + Azotobacter (T_9); 75% RDF + 50% FYM +

Phosphobacteria (T_{10}); 50% RDF + 50% FYM +Phosphobacteria (T_{11}); and 100% FYM + Azotobacter + Phosphobacteria + Trichaoderma (T_{12}); The recommended dose of N PK (80:50:90 kg/ha) Farm yard manure (20t ha^{-1}) and bio - fertilizers like Azotobacter (5kg ha^{-1}) Phosphobacteria (5kg ha^{-1}) Trichaoderma (5kg ha^{-1}) were applied as per the treatments. Fifty percent of N and full dose of P and K were applied in the furrows as per treatments and were thoroughly mixed in soil. The remaining half of the nitrogen was top dressed at 30 days after planting. The cultivar used in this study was straight eight the observations on growth yield and also quality parameters were recorded and analyzed.

RESULTS AND DISCUSSION

The growth parameters differed significantly with the influence of integrated nutrient management. The plants provided with 75% RDF+75% FYM+ Trichaoderma (T_2); recorded maximum vine length (245.33;250.16 cm) which was on par with T_4 - 75% RDF + 50% FYM + VC + Azotobacter + PSB + Trichaoderma, in both seasons summer 2010 and rabi 2011 (Table 1). The maximum number of branches per vine (7.23;7.78) was registered in the plants receiving 75% RDF + 75% FYM + Azotobacter + PSB + Trichaoderma (T_2) (Table 1) which was on par with T_4, T_6, T_1 and T_7 respectively during both the years. This could be attributed to the prevailing favorable conditions for plants in better utilization of solar radiation, nutrients and water for the synthesis of photosynthates and also might have helped in faster multiplication of cells and cellular elongation resulting in better growth of roots and shoots which helped better vegetative growth including plant height, plant spread, number of primary and secondary branches, The results obtained are in agreement with Navalakshmi et al. (2001) Krishnamanohar (2002) and Srivastava *et al.* (1993).

The maximum number of fruits per vine (10.60;12.66) was recorded with 75% RDF+75% FYM+AZT+ PSB+ TD (T_2) which was on par with T_4 -75% RDF+50% FYM+ VC+ AZT+PSB+ TD (10.03;12.03). T_4 -75% RDF+ FYM+ VC+ AZT+PSB+ TD (9.73;10.9) and T_1 -100% RDF+100% FYM+ (8.60;10.66). While, minimum number of fruits (7.63;9.11) was noticed in plants provided with 100% FYM+ VC+ AZT+PSB+ TD (T_{12}) during summer 2010 and rabi 2011 respectively (Table2).

Maximum fruit weight (270.20;349.97g) was recorded in plants fertilized with 75% RDF+75% FYM+AZT+PSB+TD (T_2) which on par with T_4 (256.98;333.22g), (T_6) (254.07;315.47g) and (T_1) (254.59;280.49g), while, lowest fruit weight (176.72;177.26g) was observed in plants d\fertilized with 100% +FYM+ AZT+PSB+ TD (T_{12}) during summer 2005 and rabi 2006 respectively. The maximum fruit yield per vine (2.42;2.45kg vine^{-1}), was recorded in plants fertilized with 75% RDF+75% FYM+AZT+PSB+ TD (T_2) during summer 2005 and rabi 2006 respectively. Application of 75% RDF+75% FYM+AZT+PSB+ TD (T_2) recorded maximum fruit yield per hectare (62.76;63.68t ha^{-1}) which was followed by T_4 -75% RDF+50% FYM+ VC+ AZT+PSB+ TD (62.73;62.47t ha^{-1}), T_4 -75% RDF+ VC+ AZT+PSB+ TD.

The increased number of fruits vine fruits weight, fruit yield vine^{-1} and total fruit yield could be attributed to better photosynthesis activity and accumulation of carbohydrates which helps in better growth of fruits. It was also related to the maximum uptake of NPK nutrients due to the influence of bio-fertilizers which provide favorable conditions around the root rhizosphere resulted in better absorption of nutrients.

These results are on agreement with the findings of Amarananundeshwara (2002) in greenhouse grown tomato and Gayathri (2003) in greenhouse grown capsicum. These results were also agreement with the in cucumber, Srivastava et al. (1993) in capsicum.

Higher yield of cucumber in the present study is also related to the influence of combined effect of organic, inorganic and bio-fertilizers which enhanced the synthesis of photosynthates and production of hormone.

Table1: Effect of integrated nutrient management on vine length, plant height and number of branches per plant at025 Days After Sowing (DAS) in cucumber grown under open condition

Treatments	90 Days after sowing(DAS)					
	Number of Leaves vine		Plant height(cm)		Number of branches plant	
	Summer,2005	Rabi,2006	Summer,2005	Rabi,2006	Summer,2005	Rabi,2006
T_1	83	89.65	200.00	212.50	7.15	8.30
T_2	88.26	91.50	245.33	250.16	8.23	8.78
T_3	79.50	80.50	190.33	196.16	6.13	6.78
T_4	84.76	90.00	203.33	215.33	7.20	8.60
T_5	43.53	81.83	189.16	198.43	6.23	7.11
T_6	86.10	91.50	242.83	248.26	7.76	8.61
T_7	81.50	84.41	199.83	204.33	7.06	8.28
T_8	81.16	84.66	199.00	202.33	6.46	7.95
T_9	77.93	79.66	185.33	192.50	6.06	6.63
T_{10}	80.50	82.83	190.83	200.16	6.30	7.48
T_{11}	77.83	79.16	173.00	179.16	5.53	6.41
T_{12}	76.83	78.33	164.66	167.16	5.50	6.11
SEm±	4.89	8.29	11.53	6.03	0.47	0.31
CD at 5%	NS	NS	33.82	17.68	1.40	0.93
CV (%)	9.80	16.07	9.82	4.90	14.69	8.35

Table2: Effect of integrated nutrient management on number of fruits per vine and fruits yield of cucumber grown under opea condition.

Treatment	No. of fruits vine^{-1}		Fruit weight(g)		Fruit weight (Kg vine^{-1})		Fruit yield(t ha^{-1})	
	Summer 2010	Rabi 2011	Summer 2010	Rabi 2011	Summer 2010	Rabi 2011	Summer 2010	Rabi 2011
T_1	8.60	10.66	245.69	280.49	2.09	2.17	54.33	56.34
T_2	10.60	12.66	270.20	349.97	2.42	2.45	62.76	63.68
T_3	7.83	9.81	214.24	223.65	1.83	2.03	47.52	52.28
T_4	9.73	10.91	254.07	315.47	2.27	2.19	59.02	57.86
T_5	7.88	9.91	221.22	266.40	1.83	2.06	50.11	52.46
T_6	10.03	12.03	256.98	333.22	2.41	2.41	62.73	62.47
T_7	7.95	10.53	239.18	274.92	1.94	2.10	50.85	54.52
T_8	7.93	10.20	231.08	272.71	1.93	2.10	50.55	54.45
T_9	7.73	9.46	210.78	221.58	1.83	2.01	42.27	52.13
T_{10}	7.91	10.08	228.07	267.56	1.86	2.08	50.11	54.01
T_{11}	7.68	9.30	209.23	206.02	1.70	1.96	44.07	50.55
T_{12}	7.63	9.11	176.72	177.26	1.52	1.95	38.62	50.41
SEm±	0.85	0.86	15.62	17.16	0.24	0.26	4.31	4.86
CD at 5%	2.51	2.52	45.83	50.35	0.72	NS	12.66	12.80
CV%	19.92	15.86	11.77	11.18	21.73	21.48	14.56	13.72

Table 3: Effect of integrated nutrient management on ascorbic acid content, TSS, moisture content and shelf life and physiological loss in weight in cucumber grown under open condition.

Treatment	Ascorbic Acid Mg/100g		TSS(BrixºBrix)		Moisture content (%)		Shelf life(Days)		Physiological loss in weight (%)	
	Summer 2010	Rabi 2011	Summer 2010	Rabi 2011	Summer 2010	Rabi 2011	Summer 2010	Rabi 2011	Summer 2010	Rabi 2011
T_1	6.13	5.58	2.90	2.56	95.00	95.60	6.81	6.96	22.58	21.01
T_2	6.50	5.91	3.00	3.16	95.50	96.06	7.18	7.86	22.25	20.58
T_3	5.76	5.25	2.63	2.23	94.50	94.50	7.02	7.37	21.71	20.21
T_4	6.36	5.70	2.93	2.60	95.06	95.66	7.30	7.87	22.46	20.66
T_5	5.76	5.35	2.76	2.33	94.66	95.00	7.03	7.58	22.00	20.30
T_6	6.40	5.75	2.96	3.00	95.16	96.00	7.37	8.00	21.80	20.58
T_7	6.06	5.50	2.86	2.43	94.90	95.33	7.51	8.01	20.66	20.00
T_8	6.06	5.41	2.86	2.40	94.83	95.33	7.11	7.60	22.50	20.93
T_9	5.53	5.12	2.60	2.20	94.40	94.50	6.87	7.25	21.68	20.20
T_{10}	5.93	5.40	2.80	2.36	94.66	95.16	7.03	7.57	22.25	20.25
T_{11}	5.43	4.91	2.56	2.20	94.33	94.33	6.83	7.18	22.16	20.28
T_{12}	5.33	4.85	2.36	2.13	94.16	91.83	7.95	8.08	19.83	19.91
SEm±	0.23	0.22	0.08	0.12	3.14	3.17	3.17	0.31	0.53	0.73
CD at %	0.68	0.64	0.25	0.36	NS	NS	NS	0.91	1.57	NS
CV (%)	6.76	7.09	5.41	8.81	5.79	5.74	6.58	7.06	4.25	6.24

like substances IAA, GA, amino acids and vitamins resulted in better growth and yield. More number of fr 'ts per plant and fruit yield per plant ultimately contributed to more fruit yield per hectare. Similar finding were also reported by Pant *et al.*, (2001), obtained are also in line with Streeck *et al.*, (1996) in cucumber.

Plants supplied with 75% FYM+AZT+PSB+ TD (T_2) (Table 3) recorded maximum ascorbic acid content (6.50mg/100 g and 5.91 mg/100 g) and TSS (3.0 ºBrix and 3.16 ºBrix) content which was on par with the treatments of T_6, T_4, T_1 and T_3 respectively during both the years. Increased in ascorbic acid and TSS conte.at of fruit in these treatments could be attributed to combined application of organic, inorganic fertilizers along with the bio-fertilizers (Azotobacter and PSB) which helped in better uptake of NPK nutrients including micronutrients which intum influence the quality traits in cucumber. The results are in conformity with the findings of Grimstand (1990), Koodzeij and Kostecka (1994) and Asano (1994) in cucumber.

The shelf-life and physiological loss in weight in mostly influenced by the storage condition, but also the quality of harvested fruits, in different treatment combination in field level. Among the treatments plants supplied with T_{11} -100% FYM+ AZT+PSB+ TD recorded the higher shelf-life of fruits in T_{11} may be attributed to effect of the growth substances which are stimulated y the use of bio-fertilizers and organic manures which slow down the physiological process like respiration of fruits leading to better retention of moisture and increased their shelf-life.

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Journal of Natural Resource and Development 7(1,2):40-54, 2012

DIET AND NUTRITIONAL STUDY OF PREGNANT WOMEN AND EFFECTS OF SUPPLEMENTATION ON THE OUT CAME OF PREGNANCY

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ABSTRACT

The reproductive cycle of a woman makes a huge demand on the nutrient requirements of the mother and affects her nutritional status considerably. The study was conducted on 200 pregnant women (16±1 week gestation) of low socio-economic status in Kalyanpur block of Kanpur district of Uttar Pradesh. One hundred pregnant women each from Kanpur city and three nearby villages (Hridaypur, Chakarpur and Singhpur Kachhar) were selected purposively to form the sample of the present investigation. It may be concluded that mean intake of cereals, pulses, roots and tubers, other vegetables, leafy vegetables, milk and milk products, fruits, fat and oils and sugar and jaggery was significantly (P<0.0 1) lower than RDA in rural and urban respondents. The various nutrients like protein, energy, calcium, iron, carotene, thiamine, riboflavin, niacin and vitamin C were found to be deficient. The inclusion of high energy and high protein recipes increased the calories, protein and mineral content of the diets of pregnant women. The developed recipes were well acceptable by the subjects. The results of the present investigation indicate that the dishes prepared from locally available low cost foods can be effectively used as a supplement for pregnant women in order to improve the nutritional status of pregnant women of central Uttar Pradesh. There is a scope to popularise these recipes as supplements as these are not only nutritious but organoleptically well acceptable by the expectant mothers.

Key words: Supplementation effective of out come of pregnancy.

Pregnant women are vulnerable to dietary inadequacies. The fundamental cause of malnutrition is found in the structure and operation of society. Malnutrition. (Gopalan, 1962) the malnutrition problem can be solved through the judicious use of inexpensive local foods, which are abundantly available in most of the villages in our Country. Mercy and Vijayalakshmi (1996) concluded from their study that iron deficiency is one of the major factors termi l lmg birth weight of babies. Pratibha (2002) studied the consumption pattern of Protein, calcium and iron in 150 pregnant women of rural and urban areas of Amritsar (Punjab). They concluded that intake of nutrients was much lower than RDA. Most of pregnant women were anemic which resulted in poor pregnancy outcome. Mohomed (2002) reported that supplementation during pregnancy appears to haemoglobin levels and folate status. Kramer (2002) a, b in his two studies on 1076 pregnant women concluded that high protein supplementation was associated with a small increase in weekly maternal weight gain.

MATERIALS AND METHODS

This chapter contains relevant information pertaining to the research design and methodological steps used for the present investigation. The study were under the following heads:

A. Food consumption pattern, food beliefs and nutrient intake of rural and urban pregnant women

B. Formulation and evaluation of dietary supplements in relation to nutritional status of pregnant women.

C. Assessment of nutritional status of pregnant women according to their BM Index.

D. Assessment of the impact of nutritional knowledge

E. Strategies for the improvement in the existing diets.

For carrying out the present study on pregnant Women, central part of Uttar Pradesh State was selected purposively as the locale of the present investigation.

Sampling procedures

Selection of district: Kanpur district of Uttar Pradesh state was selected for study.

Selection of rural localities: List of adopted villages of Kalyanpur block maintained by the B.D.O. Kalyanpur.

Selection of Urban locality: Two State Govt. Hospitals of Kanpur city

Selection of Respondents: List of pregnant women was procured fr..m the Anganwadi centres and Govt. hospitals

Socio economic status: Modified Trivedi Scale (1963).

The study was conducted on 200 pregnant women (16±1 week gestation) of low socio-economic status in Kalyanpur block of Kanpur district of Uttar Pradesh. One hundred pregnant women each from Kanpur city and three nearby villages (Hridaypur, Chakarpur and Singhpur Kachhar) were selected purposively to form the sample of the present investigation. A well structured questionnaire related to related to socio-economic status, food consumption pattern, food habits and beliefs was prepared. Pre-testing of questionnaire was done on ten respondents each from rural and urban areas.

RESULTS AND DISCUSSION

Findings revealed that majority of the rural respondents (50 per cent) were illiterate and remaining 50 were educated upto primary (25) middle (15) and high school. (10). On the contrary, in urban areas, majority of the respondents were educated upto primary school (40 per cent) and only 18 per cent were illiterate. Majority (81-85 percent) of the pregnant women from both groups were housewives. Higher percentage of women (81 per cent) from urban areas lived in nuclear family system, while joint family system was more prevalent in rural areas. Majority of the rural respondents (43 per cent) were from 21-25 years of age group whereas majority of the urban respondents (42 per cent) belonged to 26-30 years of age group. Higher percentage (38 per cent) of rural and lower percentage (25 per cent) of urban respondents were having family size above members. Eighty one per cent of the selected rural and 100 per cent urban respondents were not having any agricultural work. None of the rural or urban respondents was having social participation. Majority of the rural respondents (60 per cent) were not having milch animals while none of the urban women owned any milch animal. Cow (21 percent) and buffalo (15 percent were main milch animals kept by rural women.

Sixty seven per cent rural women were landless while 33 per cent of them were having land upto 1 hectare.

All the rural and urban women belonged to low income group. Large percentage of income was spent on food items in both groups. 75 to 80 percent women interviewed in both the areas were vegetarian. Ten per cent of rural and 4 per cent of urban subjects were having pica habits.

The data of weekly food consumption pattern Table 1 showed that wheat, onion, tomato, green chilies, buttermilk, curd and buffalo milk were consumed daily by majority of rural and urban respondents. Pulses were consumed on alternative days. Desi Ghee was used by 50 per cent rural respondents and hydrogenated fats daily in urban areas. Brinjal and cauliflower were used on alternative days in rural as well as urban areas. Lady's finger and peas were the more common vegetables and were seldom used in meals of urban subjects. Calocasia and turnip were used less commonly in both rural and urban areas. Leafy vegetables were less commonly used in diets of rural and urban respondents. Fruits were used rarely by rural respondents whereas guava, banana and apple were consumed on alternative days in season by the urban respondents.

Almost all the food items constituted a food fat. An important belief in rural areas was that food intake should be cut down during pregnancy and pregnant women need no special food. Majority of the rural respondents (90 per cent) sieved flour before kneading while 60 per cent urban subjects also follow the same practice. Rice was believed to be the main gas producing food in rural and urban both areas. Majority of the rural and urban pregnant women believed that consumption of bajra during summer leads dizziness, heart burn and skin diseases. Black gram dal and bengal gram dal should not be consumed during lactation as these produce gas.

Pulses should not be given to old women because these are heavy, was another belief in rural areas. Majority of the rural respondents (65 per cent) believed that Desi ghee can be used in any quantity and is not fattening. Radish if eaten in evening causes cold was a common belief among rural women. Majority of the rural (75 per cent) and urban (55 per cent) respondents believed that papaya is forbidden during pregnancy because it is believed to cause abortion. Twin fruits if consumed by pregnant women will result in twin or deformed child was other belief in both groups.

During this study it was noticed that a large number of food items were avoided due to one reason or other during pregnancy. Maximum number of foods were avoided during postpartum period. Foods like carrot, radish, curd, buttermilk, pickles and spices were generally not consumed during three week postpartum period.

Daily mean intake (Table 2) of cereals, pulses, roots and tubers, green leafy vegetables, other vegetables, fruits, milk and milk products, fats and oils, and sugar and jaggery was significantly ($P<0.01$) lower than the recommended allowances in rural as well as urban pregnant women. As compared to urban expectant women, the rural subjects had significantly more intake of cereals and milk and milk products. On the other hand, urban pregnant women significantly consumed more of pulses, green leafy vegetables and fats and oils. No significant differences were noted in the intake of roots and other vegetables, fruits and sugar and jaggery between the rural and urban subjects.

In terms of adequacy level, it was observed that 64 per cent of rural and 40 per cent of urban respondents were consuming marginally inadequate (49.2 and 58.0 per cent of RDA) amount of cereals during pregnancy. Majority of rural and urban respondents consumed substantially inadequate

(below 50 per cent of RDA) amount of pulses, roots and tubes, green leafy vegetables, other vegetables, milk and milk products, and fats and oils. Green Leafy vegetables were not consumed by 14 and 17 per cent of rural, and urban pregnant women, respectively.

Mean intake (Table 3) of protein, energy, calcium, iron, carotene, thiamine, riboflavin, niacin and vitamin C was significantly (P<O.O 1) lower than the recommended allowances among both rural and urban pregnant women. Rural respondents consumed significantly (P<0.01) higher amount of iron and carotene as compared to their urban counterparts. However, the intake of protein, energy, calcium,, thiamine riboflavin niacin and vitamin C was similar in rural and urban women.

On the whole protein intake both by rural and urban respondents were marginally inadequate. The intake of energy, calcium, iron riboflavin, niacin, Vitamin C and thiamine was marginally inadequate in rural and urban respondents except carotene which was substantially lower in urban women.

A significant (P<0.01) effect of independent variables (type of family and education) was witnessed on the food and nutrient intake of the rural and urban respondents. Type of family had an influence on the intake of pulses, green leafy vegetables, roots and tubers, other vegetables, fruits, sugar and jaggery and fats and oils. The consumption of roots and tubers and milk and milk products was not affected by educational level, Intake of carotene was more in pregnant women of illiterate group whereas the intake of niacin was higher in pregnant women of educated group. The intake of protein, energy, calcium, iron, thiamine, riboflavin and vitamin C was not affected by literacy.

The mean height, weight and haemoglobin levels of the rural respondents were higher as compared to those of the urban respondents. Angular stomatitis, cheiosis, pale conjuctiva of eyes, bleeding gums, anaemia were the most common clinical symptoms found among expectant women. Data revealed that incidence of nutritional deficiencies was much higher in urban as compared to rural respondents.

Four low cost nutritious recipes namely nutritious chikki, nutritious Panjiri, groundnut rice and sprouted bengal gram (Table 4 and 5) were standardized. Chemical analysis of these recipes revealed that groundnut rice had the lowest (11.06 per cent) and nutritious Chikki the highest (15.28 per cent) content of protein. The fat content of sprouted bengal gram was the minimum. The crude fibre content of all the developed recipes was very low (1.16 to 1.99 per cent). Sprouted bengal gram had the maximum ash content (2.60 per cent) and groundnut rice the minimum (1.20 per cent). The soluble carbohydrate content of nutritious Panjiri was found to be maximum (66.40 per cent), followed by nutritious Chikki (55.66 per cent), sprouted bengal gram (48.82 per cent) and groundnut rice (48.58 per cent). Among all, the developed recipes, nutritious Chikki had the highest (457.68 KCa1/ 100g) and groundnut rice lowest (309.64 KCa1/100g) energy content. Nutritious Panjiri had highest amount of phosphorus and iron.

Organoleptically, all the recipes prepared were acceptable in terms of colour, appearance aroma/ flavour, taste, and texture.

The overall acceptability scores for all foods ranged. from "moderately desirable" to "desirable" category.

Out of 100 rural pregnant women (Table 6, 7 and 8) shows, 60 women were selected for supplementation studies. The selected women were divided into three groups, i.e. 20 women in Hridaypur Village as experimental group, 20 women in Chakarpur as ICDS group and 20 women in Singhpur Kachhar as control group. The feeding trial was conducted for a

Table 1: Weekly food intake frequency of pregnant women (per cent)

Foods	Rural				Urban			
	Daily	Alternative days	Seldom	Rarely	Daily	Alternative days	Seldom	Rarely
Cereals								
Wheat	100	0	0	0	100	0	0	0
Rice	0	48	32	20	0	50	30	20
Maize	0	47	32	21	0	0	10	90
Bajra	0	2	58	40	0	0	24	76
Pulses								
Bengal gram	0	47	26	27	0	40	38	22
Black gram	0	13	55	32	0	19	80	1
Green gram	0	24	52	24	0	30	38	12
Red gram	0	20	48	32	0	36	49	15
Lentil	0	8	48	44	0	20	30	50
Rajma								
Cabbage	0	20	62	1	26	43	27	30
Coriander	0	0	52	48	0	19	40	15
Fenugreek leaves	0	9	42	49	0	28	28	44
Mustard leaves	0	21	37	42	0	15	50	35
Bengal gram leaves	0	6	55	39	0	0	16	84
Spinach	0	19	43	38	0	18	40	42
Mint	0	0	35	65	0	28	52	20

Roots and tubers								
Radish	14	46	30	10	35	50	6	9
Carrot	22	35	3	40	40	51	3	6
Potato	65	21	9	5	79	21	3	6
Onion	79	11	6	4	90	6	4	0
Colocasia	0	0	0	100	0	0	52	48
Sweet potato	0	0	56	44	0	26	62	12
Ginger	0	0	20	80	0	32	45	23
Garlic	0	0	0	100	0	40	36	24
Turnip	0	0	60	40	0	0	36	64
Brinjal	0	21	39	40	0	33	2	23
Tomato	86	10	2	2	100	0	0	0
Cauliflower –	0	35	64	1	0	43	27	30
Green chilies	100	0	0	0	100	0	0	0
Lady's finger	0	0	72	28	0	22	68	10
Peas (green)	0	0	61	39	0	40	52	8
Fruits								
Guava	0	0	0	100	0	56	40	4
Apple	0	0	0	100	0	30	67	3
Banana	0	0	0	100	0	40	52	8
Ber	0.	0	0	100	0	0	62	38
Dates	0	0	0	100	0	0	10	90
Lemon	0	0	9	91	0	12	80	8
Orange	0	0	60	40	0	22	65	13
Papaya	0	0	0	100	0	0	0	100

Milk &milk products								
Cow's milk	40	22	20	18	20	40	35	5
Buffalo's milk	59	12	16	13	82	10	6	2
Goat's milk	0	0	69	31	0	0	80	20
Curd	52	40	6	2	80	19	1	0
Buttermilk	90	10	0	0	30	25	35	10
Butter	0	20	67	13	0	0	40	60
Fat and edible oils								
Desi Ghee	50	25	25	0	40	30	30	0
Hydrogenated oil	0	61	30	9	100	0	0	0
Mustard oil	90	10	0	0	0	62	31	7

Table 2: Comparative food intake of rural respondents of Hridaypur, Chakarpur and Singhpur Kachhar

Food groups	RDA (ICMR, 1980)	Hridaypur			Chakarpur			Singhpur Kachhar		
		Intake (n=50)	RDA (per cent)	't' value	Intake (n=50)	RDA (per cent)	't' value	Intake (n=50)	RDA (per cent)	't' value
Cereals	400	219±53 (108-311)	54.7	16.5	342±52 (109-511)	85.5	10.4**	234±36 (110-312)	58.5	23
Pulses	70	20.8±5.3 (14-30)	29.7	17.9**	17.6±5.2 (10-35)	25.1	21.5**	21.1±7.5 (6-38)	30.1	30
Roots and tubers	75	23.2±10.2 (10-50)	30.9	21.6**	24.2±1.6 (9-52)	32.3	16.3*	21.7±6.2 (10-45)	28.9	41.6*
Green leafy vegetables	150	24.5±11.1 (4-36)	16.3	51.2*	53.1±27.5 (6-41)	35.4	2.3*	25.9±17.2 (8-59)	17.3	42
Other vegetables	75	23.2±9.4 (3-35)	30.9	28.1*	14.2±5.7 (5-40)	30.9	5.7**	20.1±8.3 (6-42)	26.8	30
Fruits	30	0	-	-	0	-	6.4**	0	-	16
Milk and milk products	325	178±69 (100-355)	54.8	8.9**	186±81 (65-300)	57.2	10.6**	152±50 (70-320)	46.8	37.2**
Fats and oils	35	14.2±4.8 (8-26)	40.6	20.6**	17±7.4 (5-28)	49.7	10.3**	11.0±3.4 (6-20)	31.4	30
Sugar and Jaggery	40	13.5±4.9 (5-30)	33.7	21.8	16.8±5.2 (4-30)	42.0	6.1**	14.6±5.7 (3-35)	36.5	21

Means ± S.D. ** Significant at 1% level

Figures in parenthesis indicate the range

Table 3: Comparative food intake of rural respondents of Hridaypur, Chakarpur and Singhpur Kachhar

Food groups	RDA (ICMR, 1984)	Hridaypur			Chakarpur			Singhpur Kachhar		
		Intake (n=50)	RDA (per cent)	't' value	Intake (n=50)	RDA (per cent)	't' value	Intake (n=50)	RDA (per cent)	't' value
Protein (g)	65	44.1±4.1 (18.0-54.3)	67.8	11.6**	46.7±8.6 (30.7-62.5)	71.8	10.4**	47.5±5.7 (19.6-64.8)	73.0	1
Energy (KCal)	2525	1489±3.22 (992-2480)	58.9	12.9**	1501±240 (960-2291)	59.4	2.1	1466±130 (955-2160)	58.1	18.1**
Calcium (mg)	1000	527±208 (345-1100)	52.7	10.9**	597±115 (220-9 16)	59.7	10.1*	598±129 (205-1075)	59.8	18.0**
Iron (mg)	38	28.5±6.1 (18.5-38.6)	75.0	75**	34.2±9.5 (18.9-45.8)	90.0	2.1*	30.5±7.1 (17.2-40.5)	80.1	49**
Carotene (ug)	2400	1291±1030 (375-3100)	53.8	6.7**	1742±718 (408-3960)	72.6	57**	1540±521 (500-3500)	73.8	10.1**
Thiamine (mg)	1.3	1.03±0.18 (0.60-1.41)	79.2	6.5*	1.11±0.21 (0.55-1.78)	85.4	6.4**	1 (0.72-1.45)	83.8	6.1**
Riboflavin (mg)	1.5	0.88±0.21 (0.50-1.20)	58.7	11.8**	0.91±0.36 (0.39-1.25)	60.7	40.9**	0.79±0.19 (0.54-1.28)	52.7	18.1**
Niacin (mg)	16	11.3±3.5 (8.3	70.6	6.9**	12.3±1.8 (8.6-16.1)	79.4	10.3	12.1±1.8 (7.6-17.6)	76.9	6.1**
Vitamin C (mg)	40	15.9±12.1 (6.6-69.5)	39.7	8.1**	22.6±19.1 (9.5-134.6)	56.5	6.3**	16.4±6.1 (9.2-50.8)	40.8	12

Means ± S.D. ** Significant at 1% level

Figures in parenthesis indicate the range * Significant at 5% level

Table 4: Chemical composition of developed recipes on dry matter basis

Composition	RECIPES			
	Nutritious chilldi	Nutritious Panjiri	Groundnut Rice	Sprouted Bengal gram
Moisture (%)	6.77 ±2.1	5.56 ± 0.83	30.10 ± 2.30	28.20 ± 1.80
Protein (%)	15.20 ±1.5	14.27 ± 0.37	11.06 ± 0.65	13.16 ± 0.70
Crude Fat (%)	19.36 ±2.20	9.87 ± 1.30	7.90 ± 0.85	5.12 ± 0.81
Crude Fibre (%)	1.64 ± 0.30	1.38 ±0	1.16 ± 0.15	1.99 ± 0.60
Soluble carbohydrate (%)	55.66 ± 2.15	66.40 ± 3.70	48.58 ± 1.72	48.82 ± 2.50
Energy (K cal/ 100g)	457.68 ±1.10	411.51 ±2.90	309.64 ± 4.02	294.00 ± 1.50
Ash (%)	1.35 ± 0.15	2.52 ±0	1.20 ± 0.20	2.60 ± 0.40
Calcium (mg/ 100g)	122.20 ± 1.80	150.25 ± 2.32	105.20 ± 1.62	157.11 ± 2.01
Phosphorus (mg/ 100g)	230.15 ±2.40	285.11 ± 2.15	205.82 ± 1.80	270.17 ± 2.50
Iron (mg/100g)	10.90 ± 0.55	14.90 ± 0.52	9.05 ± 0.96	9.90 ± 0.80

Table 5: Nutritive value of developed recipes (g/100g edible portion)

Recipes	Components	Protein (g)	Energy (kcal)	Iron (mg)
1. Nutritious Chikki	Groundnut	12.15	0.13	—
	Jaggery	272	122	27
	Cooking Oil	1.30	3.60	—
	Total	12.28	421	4.90
2. Nutritious Fanjiri				
	Wheat Flour	9.68	272	3.90
	Bengal Gram Flour	1.70	36	1.02
	Groundnuts	2.50	57	0.28
	Jaggery	0.16	153	4.56
	Cooking Oil	-	27	—
	Total			
3. Groundnut Rice	Rice	6.12	311	2.79
	Groundnut	5.06	113	0.56
	Jaggery	0.16	153	4.56
	Cooking Oil	-	27	—
	Total	11.34	604	7.91
4. Sprouted Bengal gram	Bengal gram	18.81	396	11.2
	Cooking Oil	-	27	-
		18.81	423	11.2

Source : Nutritive value of Indian foods (Gopalan *et al.* 1991).

Table-6: Distribution of rural pregnant women according to adequacy of nutrient intake (n =100)

	Protein			Energy			Calcium			Iron			Carotene		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Hridaypur	3	19	9	4	10	17	5	12	10	8	10	10	2	7	22
Chakarpur	6	21	11	7	21	10	7	25	10	7	20	10	5	10	24
Singhpur	3	20	8	4	14	13	3	8	20	6	17	12	3	6	21
Kachhar															
Total	12	60	28	15	45	40	15	45	40	21	47	32	10	23	67

	Protein			Energy			Calcium			Iron		
	I	II	III	I	II	III	I	II	III	I	II	III
Hridaypur	6	17	7	4	3	20	4	8	20	5	9	20
Chakarpur	6	18	10	6	7	28	4	20	15	10	18	10
Singhpur	6	18	10	6	7	28	4	20	15	10	18	10
Kachhar	6	19	11	3	5	22	4	12	13	6	4	18
Total —	18	54	28	13	15	72	12	40	48	21	31	48

75% and above of RDA lequate)
Below 50% of RDA ib stantia]ly Inadequate
e categories with nil response have en deleted
II- 50 to 74 of RDA (Marginally inadequate)
IV Nil intake

Table 7: Haemoglobin Levels of Pregnant women in the Three groups (g/ 100 ml of Blood).

Sl. No.	GROUPS: Experimental (n=20)			ICDS (n=20)			Control (n=20)		
	Initial	Final	Gain	Initial	Final	Gain	Initial	Final	Gain
1	8.02	8.96	0.94	8.50	9.05	0.55	9.00	9.15	0.15
2	8.81	9.40	0.59	8.30	8.75	0.45	8.30	8.40	0.10
3	889	960	071	880	935	055	840	850	010
4	800	865	065	850	900	055	735	740	005
5	9 65	10 55	0 90	9 60	10 10	0 50	9 30	9 35	0 05
6	805	875	070	880	935	055	790	805	015
7	9.36	10.00	0.64	8.75	9.30	0.55	8.30	8.40	0.10
8	8.75	9.30	0.55	8.70	9.20	0.50	8,50	8.45	0.05
9	8.88	9.40	0.52	9.10	9.65	0.55	9,10	9.20	0.10
10	9.16	10.00	0.84	8.70	9.20	0.50	8	8.90	0.10
11	9.10	10.02	0.92	9.30	9.80	0.50	8.00	8.10	0.10
12	8.95	9.85	0.90	8.90	9,30	0.40	6.50 .	6.55	0.05
13	9.68	10.32	0.64	8.80	9.25	0.45	7.30	7.40	0.10
14	962	1009	047	940	985	045	770	780	010
15	8.98	9.80	0.82	9.80	9.30	0.50	8.90	8.95	0.05
16	7.92	8.80	0,88	8.30	8.80	0.50	8.95	9.10	0.15
17	7.56	7.95	0.39	9.32	9.80	0.48	9.20	9.25	0.05
18	7.89	8.30	0.41	6.80	7.50	0.70	9.10	9.80	0.70
19	8.90	9.75	0.85	8.30	8.70	0.40	8.30	8.40	0.10
20	8.80	9.62	0.82	7.35	7.75	0.40	8.10	8.20	0.10
Mean	8.62	9.32	0.70	8.62	9.00	0.50	8.60	8.72	0.12
SD±	0.71	0.68	0.09	0.71	0.58	0.08	0.58	0.06	.04

Table 8: WEIGHT GAIN (KG) DURING PREGNANCY

Code	Control gr ..p				Net weight gain					Net weight gain					Net weight gain
	Period (months)					Period (months)					Period (months)				
	Initial	3	6	9		Initial	3	6	9		Initial	3	6	9	
1	40.2	41.0	42.2	45.9	5,7	41.2	42.0	46,1	49.2	8,0	40.8	41.5	44.3	4.8.9	8.1
2	39.8	40.9	42.8	45.2	5.4	42.9	43.8	46.7	51.9	9.0	42.9	43.5	47.2	51.9	9.0
3	45.1	45.9	44.2	49.9	4.8	36.5	37.3	40.1	43.5	7.0	37.8	38.7	41.5	45.9	8.1
4	47.2	47.9	50.0	52.8	5.6	38.2	39.2	40.8	46.1	7.9	39.5	40.1	44.0	48.0	8.5
5	38.2	39.2	41.3	44.3	6.1	46.8	47.7	50.1	55.2	8.4	45.2	46.0	49.1	53.6	8.4
6	41.6	42.4	45.0	47.8	6.2	45.2	46.0	49.0	52.9	7.7	46.4	47.3	51.2	54.7	8.3
7	43.2	43.9	46.0	50.0	6.8	36.9	37.8	40.2	45.2	8.3	43.5	44.1	48.3	52.5	9.0
8	45.4	46.8	47.0	52.1	6.7	43.5	44.1	46.3	49.9	6.4	50.5	51.2	53.9	58.4	7.9
9	47.2	47.9	50.1	54.0	6.8	51.0	52.0	53.3	59.5	8.5	36.8	37.5	41.6	44.8	8.0
10	48.2	48.9	51.3	55.2	7,0	49.0	49.8	53.6	58.5	9.5	45,2	46.0	49.7	53.5	8.3
11	49.2	49,9	52.6	55.8	6.6	42.5	43.4	46.9	51.0	8.5	39,8	40.5	43.9	48.0	8.2
12	41.4	42.6	44.3	48.8	7.4	39.2	39.9	43.0	47.5	8.3	46.5	47.3	52.0	56.1	9.6
13	42.8	43.7	45.2	49.8	7.6	42.5	43.2	46.2	49.8	7.3	42.9	43.5	47.6	52.3	9.4
14	36.4	37.6	39,3	43,6	7.2	44.5	453	48.3	52.6	8.1	44.5	45.1	49.0	53,1	8.6
15	39.2	39.9	42.1	45.9	6.7	41.6	42.3	46.0	49.0	7.4	48.5	49.2	53.3	57.2	8.7
16	38.5	39.2	41,5	44.7	6.2	39.8	40.5	43.0	47.9	8.1	47	48.1	52.0	56.5	9
17	37.6	38.2	40.2	43.5	5.9	38.5	39.2	41.9	4.5.5	6.9	50.5	51.2	53.6	58.9	8,4
18	41.2	41.8	43.9	48.1	6.9	45.5	46.2	50.3	54.7	9.2	41.5	42.1	47.0	50.0	8.5
19	45.4	46,4	48.2	51.2	5.8	46.5	47.8	51.0	55.3	8.8	43,5	44.2	47.4	53.7	10.2
20	42.4	43.6	45.6	48.5	6.1	42.9	43.4	46.2	51.1	8.2	42.5	43.1	46.1	50.7	8.2
Mean	42.5	43.4	45. 2	49.7	5.5	42.9	43.5	46.3	51.8	8.1	42.2	44.5	48.4	53.4	9.2
SD±	4.3	4.1	3.9	3.7	0.7	3.9	4.1	4.3	4.5	0.9	4.3	3.7	3.9	4.0	0.7

period of six months. One recipe fed to the ICDS group was panjiri. In the experimental group, four developed recipes, i.e. Nutritious Chikki, Nutritious Panjiri, groundnut rice and sprouted bengal gram was given. Control group was not given any supplement.

Records of weight gain and haemoglobin levels from the fourth month of pregnancy to full term were maintained for the individual subjects in the three groups, i.e., experimental, ICDS and control group. The average weight gain of ICDS group was significantly (P<0.0 1) higher than that of the control group. There was a significant (P<zO.0 1) increase in. the haemoglobin level of the experimental group as compared to ICDS and control groups.

The general Body Mass Index (BMI) of rural as well as urban women was low normal. Only 10-15 per cent women were in normal group. None of pregnant women was obese. Chronic energy deficiency was found in 15 to 17 per cent women.

Significant differences in net weight gain of pregnant women at 9 months of pregnancy was observed. Maximum weight gain (9.2 kg) was found in experimental group followed by ICDS (8.1 kg) and control (5.5 kg). Increase in weight gain was 47.27 and 67.27 per cent higher in ICDS and experimental group women respectively. Higher weight gain was clear indication of better child development.

Nutrition education imparted through different methods improved the nutritional knowledge of the mothers. It was helpful to correct wrong food beliefs and food practices of the experimental group. There was a significant (P<0.01) increase in the gain in knowledge of experimental group.

It may be concluded that mean intake of cereals, pulses, roots and tubers, other vegetables, leafy vegetables, milk and milk products, fruits, fat, oils, sugar and jaggery was significantly (P<0.0 1) lower than RDA in rural and urban respondents. The various nutrients like protein, energy, calcium, iron, carotene, thiamine, riboflavin, niacin and vitamin C were found to be deficient. The inclusion of high energy and high protein recipes increased the calories, protein and mineral content of the diets of pregnant women. The developed recipes were well acceptable by the subjects. The results of the present investigation indicate that the dishes prepared from locally available low cost foods can be effectively used as a supplement for pregnant women in order to improve the nutritional status of pregnant women of central Uttar Pradesh. There is a scope to popularise these recipes as supplements as these are not only nutritious but organoleptically well acceptable by the expectant mothers.

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Journal of Natural Resource and Development 7 (2): 75-80, 2012

EFFECT OF OXYTOCIN ON THE PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF BUFFALO AND CATTLE IN ALLAHABAD

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ABSTRACT

Experiment was designed to evaluate the effect of oxytocin on the production and the reproductive performance of pre and post-parturient cattle and buffaloes. A total of 60 animals including 30 cattle and 30 buffaloes were randomly divided into three experimental groups of twenty animals according to their age. In Group I animals were of the age up to 2 years; Group II from 3-4 year and Group III. from 4-5 years. Both productive and reproductive data of animal was collected through questionnaire from the owner. The reproductive disorders were identified by rectal palpation. The milk yield, milk fat and reproductive disorders were monitored in each cow and buffalo. It is concluded that treatment with oxytocin following parturition did not help in improving the productive and reproductive performances of post-parturient buffaloes and cattle.

Key words: *abortion, anestrous, buffalo, cattle, conception, puberty, pregnancy, retention of placenta*

At present, livestock is contributing about 49.6 per cent of agricultural value added and 10.6 per cent to the GDP. Foreign earnings of the livestock sector exceed 35 billion rupees annually. Dairy cattle and buffalo produced 25.04 billion liters of milk. Livestock also provides wool, hair, hide, skin, blood, bones, and farmyard manure and is a principal source of work power for cultivation and rural transport. The role of livestock in rural economy may be assessed by the fact that 30 to 35 million of the total rural population is engaged in livestock related activities, having household holdings of 2 to 3 cattle / buffalo and 5 to 6 sheep and goats per family, deriving 30 to 40 per cent of income from it (Anonymous 2006-07). Buffaloes have been used for milk production for centuries. They have not been subjected to the same upgrading and breeding like cattle in the western world.

Oxytocin word is derived from Greek which means "quick birth". Oxytocin is made in magnocellular neurosecretory cells in the supraoptic nucleus and paraventricular nucleus of the hypothalamus and is released into the blood from the posterior lobe of the pituitary gland. Oxytocin is also produced in the corpus luteum of the buffalo and cow (Wathes et al 1983). Oxytocin is secreted into the blood at orgasm – in both males and females. Half-life of oxytocin in blood is 0.55 to 3.6 minutes. Synthetic oxytocin is sold as generic oxytocin. Injected oxytocin analogues are used to induce labor and support labor in case of non-progression of parturition to facilitate birth. Physiologically important for cervical dilation before birth and causes contractions during the second and third stages of labor. Oxytocin release during calf-feeding causes mild but often painful uterine contractions during the first few weeks of lactation. This also serves to assist the uterus in clotting the placental attachment point postpartum. Increase in oxytocin concentration over a threshold level and milk ejection occurred simultaneously and was closely

correlated. The stripping yield was higher and fat content in the stripping yield significantly lower. Thus buffaloes are easily disturbed even by small changes in milking routines. (Thomas et al 2005). In Pakistan, unfortunately oxytocin is using by the owner to increase milk production without knowing any problem occur to the animal. Oxytocin is usually injected intra-muscularly in a dose of 10-20 IU immediately before each milking. The purchase of oxytocin does not require any prescription and is easily available even on a general store of a village. This field study is done to find out the problems (productive and reproductive) occurred in buffaloes and cattle after using oxytocin

MATERIALS AND METHODS

For this study, 60 animals including 30 cattle and 30 buffaloes from the civil veterinary hospital for the treatment of reproductive disorders in Allahabad rural area were selected. They were divided according to the age determined from the teeth of the animal (O'Connor, 1980). Milking management practices of the selected livestock owners were then studied in detail by visiting and observing these villages. The visit of these livestock villages and interview with the help of questionnaire with livestock owners was conducted by the researcher to collect in formations about those animals injected with Oxytocin before milking during whole year (365 days). Milking of each animal was done at 08:00 AM and 16:00 PM. Precautions were taken to prevent conditioned release of oxytocin before milking and was ensured that the milk let down was attributed to the particular stimuli tested i.e., administration of oxytocin or milk evacuation. Some of these precautions were: personnel (samplers and milkers) presence at the time of milking, clean place, proper washing of udder of animal, proper washing of hands of milker and activities including feeding, bring the animal to milking place, standing of animal in line and bringing of calf near to cow and buffalo started at least half hour before actual milking. A detailed questionnaire and observations sheet was developed to collect the relevant information on the selected variables (Goode and Hatt, 1957). The major parameters considered for the study in these animals were puberty, milking procedure, conception rate, calf mortality, abortion, milk let down and retention of placenta. The fat in milk was measured with Galvanometer (Shaw, 1942). Reproductive disorders were detected by rectal palpation (Baillie *et al*., 2003). The data was then analyzed statistically (Steel and Torry, 1981).

RESULTS AND DISCUSSION

Information regarding the source which inspires Oxytocin utilization for better productive performance was collected through questionnaire from the owner of the animals. Consumption of frequently oxytocin injected animal's milk by the calf resulted in

Table 1 : Effect of oxytocin on reproductive disorders in buffalo and cattle.

Problem	Buffaloes (N-30)			Cattle (N-30)		
	2 year (n-10)	3-4 year (n-10)	5-6year (n-10)	2year (n-10)	3-4year (n-10)	5-6year (n-10)
Early Puberty	-	-	-	-	-	-
Delayed Puberty	(6) 50%	(2)20%	-	(2)20%	(1)10%	-
Low Conception Rate	(2)20%	(4)40%	(1)10%	(4)40%	(3)30%	(6)60%
Animal pregnant(Decrease)	(1)10%	(1)10%	(6)60%	(2)20%	(4)40%	(2)20%
Abortion	(1)10%	(2)20%	(3)30%	(1)10%	(1)10%	(2)20%
Calf Death after delivery	-	(1)10%	-	(1)10%	(1)10%	-

delayed puberty in them, low conception rate, low pregnancy chances, increased abortion rate and death of calf soon after delivery as shown in (Table 1).

The frequent use of oxytocin by the owner of the animal resulted in different productive problems. In buffalo, oxytocin used to increase milk production 96.66%, Dead Fetus 13.33%, Difficult Birth 71.66%, Retention of Placenta 38.33% and Milk let down 96.66% while in cattle used to increase milk production 90%, Dead Fetus 10%, Difficult Birth

Table 2 : Reasons to use of oxytocin by the owner to the animal.

Reason	Buffalo (N-30)	Cattle (N-30)
Increase Milk yield	(14) 46.67%	(10)33.33%
Dead Fetus	(1)3.33%	(3)10%
Difficult Birth	(7)23.33%	(9)30%
Retention of Placenta	(5)16.67%	(5)16.67%
Milk let down	(3)10%	(3)10%

58.33%, Retention of Placenta 30% and Milk let down91.66% as shown in (Table 2).

The misapprehension of the people about the use of oxytocin injection to increase the milk production of animal established erroneous and rejected in present study. From this study, it was found that animal injected with oxytocin showed decrease

Table 3 : Effect of oxytocin on milk yield and fat percentage in buffalo and cattle.

	1st day	1 week	1 month	3 month	6 month	9 month	1 year
Buffalo (N-30)							
Milk yield, L	12	12.3	10	9.3	9	8.6	8
Milk fat, %	8.5%	8%	8%	7%	5.7%	5%	4.2%
Mastitis	38.33%	18.33%	31.66%	35%	26.66%	20%	30%
Cattle (N-30)							
Milk yield, L	18	18	16.8	16	15.4	13.9	11
Milk fat %	6.2%	6.2%	5.8%	5.5%	4.9%	4%	3.7%
Mastitis	20%	35%	23.33%	26.66%	15%	6.66%	11.66%

in milk yield, milk Fat percentage and also suffered with mastitis during this period as shown in (Table 3).

Frequent use of oxytocin resulted in various reproductive disorders in both buffalo and cattle including Follicular ovarian cyst 18.33%, Carpus Luteum cyst 28.33%, Retention of Placenta 11.66%, Anestrous 16.66% and Repeated Estrus 25% in buffalo and Follicular cyst 26.66%, Corpus Luteum cyst 23.33%, Retention of Placenta 8.33%, Anestrous 18.33% and Repeated Estrus 23.33% respectively

Table 4 : Effect of oxytocin on the reproductive disorders of buffalo and cattle.

Reproductive Disorder	Buffalo (N-30)	Cattle (N-30)
Follicular cyst	(6)20%	(12)30%
Corpus Luteum cyst	(12)30%	(7)23.33%
Retention of Placenta	(3)10%	(2)6.67%
Anestrous	(4)13.33%	(3)10%
Repeated Estrus	(5)16.66%	(6)20%

in case of cattle is shown in (Table 4).

Oxytocin is a drug to facilitate in parturition but in Pakistan this has also been commonly used to enhance the milk production in animals. It is frequently used by the owners of the animals from day one after parturition to increase the milk production. This mal practice leads to different reproductive disarray in the animals. Practice of using oxytocin for milk let down has many draw backs and harmful effect on our dairy industry. The animals regularly exposed to oxytocin become habitual to the drug and let down of milk without its administration is difficult. Repeated injections of oxytocin therefore, interfere with normal milk secretary activity of mammary epithelium and inhibits normal ejection reflex. It is believed that prolonged use of oxytocin also causes fertility disorder i-e. Poor estrus sign, low conception rate, reduced lactation period, high embryonic mortality in local herds of buffalo and cattle (Siddiqui and Saeed, 2000), Delayed puberty, low conception rate, low pregnancy chances, increased abortion rate and calf dead soon after delivery because of non availability and poor quality of milk. These findings are in agreement with (McDonald, 1989; Dominguez *et al.*, 1993; Hassan, 1993; Qureshi, 1998). Both productive and reproductive Findings including Delayed Puberty, Number of pregnancies, Abortion, Dead Fetus, Difficult Birth, Retention of Placenta, Milk let down Decreased milk production and milk Fat percentage in cattle and buffalo are found in agreement with (Shaw, 1942; Bhullar *et al.*, 1991; Thomas *et al.*, 2004; Murugaiyal *et al.*, 2001; Weiss *et al.*, 2002; Weiss *et al.*, 2003 a, b; Dzidic *et al.*, 2004; Bidarimath and Aggarwal, 2007; Ariota *et al.*, 2007) while Thomas *et al.*, (2005) reported increased in milk production. Reproductive anomalies observed Follicular ovarian cyst, Carpus Luteum cyst, Retention of Placenta, Anestrous and Repeated Estrus in buffalo and cattle are in agreement with the work of (Labhsetwar *et al.*, 1964; Cameron and Fosgate, 1964; Booth and McDonald, 1982; Peters and Laven, 1996; Tiwari *et al.*, 1999; Mavi *et al.*, 2004; Drillich *et al.*, 2006; Drillich *et al.*, 2007).

CONCLUSION

From the present study, it was found that the farmers are using Oxytocin without the veterinarian's advice resulted in loss both in productive and reproductive performance of their animals. The frequent use of oxytocin in animals also caused decrease birth rate, low quality of milk produce and animals culled earlier because of uncured reproductive disorders.

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Journal of Natural Resource and Development 7(1,2):61-63, 2012

STUDY OF DIETARY PATTERN OF SCHOOL GOING CHILDREN OF FAIZABAD DISTRICT

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ABSTRACT

Four hundred school going children in the age group of 7-9 years were selected by purposively sampling technique from schools of Faizabad. Survey method was adopt in order to collect the data from the selected respondents with the help of pre tested standardized interview schedule. The pattern of children reveled that a large proportion of them were like sweet and salty both type of food. On the other hand good percentage of school going children take cereals and pulses because it is staple food and include in Mid Day Meal.

Key words: dietary pattern, MDM, Children

Children are the future of the country. The importance of child health has been described by many unani physicians. In India, children under 15 years of age constitute about 40 percent of the population. School children constitute a large pool of children of this age group. Nutritional status is a major component of school health services (Izharual et al. 2011). Over 1/5th of our population comprises of children aged 5-14 years i.e. the group covering primary and secondary education (Raghava 2005). As today's children are the citizen of tomorrow's world, their survival, protection and development are the prerequisite for the future development of humanity (WHO 1996). Growth during childhood is widely used to assess adequate health, nutrition and development of children and to estimate overall nutritional status as well as health status of the population. It is well documented that chronic under nutrition is associated with slower cognitive development and serious health impairment later in life which reduce the quality of life (Scrimshaw 1995). Health of children is of great importance as rapid growth occurs during this period (Shashi, 1990). Good nutrition is a basic requirement for good health and a living organism is a product of nutrition (Begum 1997).

MATERIALS AND METHODS

Research methodology is the plan, structure and strategy of investigation, so as to obtain answer to research question and control variance plan in the overall scheme.

(i) **Location of study**- The study was conducted in primary schools of Mawai Block of Faizabad District.

(ii) **Sample Selection** – 400 school going children were selected for the study which was selected from different primary schools through purposively sampling. The dietary information of the subject was collected with the help of questionnaire.

(iii) **Collection of Data**- The primary tool used in the study was a detailed performa. The information was obtained from the respondents by questionnaire cum interview method. Each subject was contacted individually and was persuaded to answer all the questions in the questionnaire and their responses were recorded.

Statistical Tools:- The Collected data were classified in the light of the objective of study. The classified data were, tabulated and analyzed statistically with the help of approved statistical techniques.

Percentage

The percentage values are calculated to make simple comparison.

$$\text{Percentage} = \frac{f}{N} \times 100$$

Where, f = Frequency of respondents

N = Total Number of respondents

RESULTS AND DISCUSSION

Table 1 shows the distribution of respondents on the basis of their dietary pattern. From the data it is evident that maximum girls respondents, 44.23 percent were vegetarian, 36.05 percent girls respondents were non-vegetarian and 19.71 were eggitarian. Maximum boy respondents, 37.50 percent were vegetarian, 32.81 percent respondents were non-vegetarian and 29.68 percent respondents were eggitarian.From the data it is evident that maximum girls respondents, 33.17percent adopted Type 'B' (Breakfast + Lunch + Tea + Dinner) meal pattern and maximum boys respondents, 33.33 percent adopted Type 'C' (Breakfast + Mid Morning + Lunch + Tea + Dinner) meal pattern. Whereas minimum girls respondents, 13.46 percent adopted Type 'D' (Breakfast + Mid Morning + Lunch + Tea + Dinner + Bed Time) meal pattern and minimum boys respondents, 15.62 percent adopted Type 'A' (Breakfast + Lunch + Dinner) meal pattern.

Table 1: Distribution of respondents on the basis of their dietary pattern

Dietary Pattern	Girls	Percentage	Boys	Percentage	Total	Percentage
Vegetarian	92	44.23	72	37.50	164	41.00
Non-vegetarian	75	36.05	63	32.81	138	34.50
Eggitarian	41	19.71	57	29.68	98	24.50
Total	208	99.99	192	99.99	400	100.00

Table 2: Distribution of respondents on the basis of their dietary intake

Dietary Intake	Pre intervention					
	Girls n = 208	Percentage	Boys n = 192	Percentage	Total	Percentage
Type "A"	48	23.07	30	15.62	78	19.50
Type "B"	69	33.17	48	25.00	117	29.25
Type "C"	63	30.28	64	33.33	127	31.75
Type "D"	28	13.46	50	26.04	78	19.50

Table 3 evident that maximum girls respondents and boys respondents (28.36 percent and 28.12 percent) liked sweet and salty both type of food. As well as minimum girls respondents and boys respondents (11.53 percent and 14.06 percent) liked sweet foods.

CONCLUSION

It can be concluded from the above data majority of respondents were vegetarians and they like sweet and salty both type of foods in their diet.

Table 3: Distribution of respondents on the basis of type of food liked by respondents

Food Type	Pre intervention					
	Girls n=208	Percentage	Boys n=192	Percentage	Total	Percentage
Sweet	24	11.53	27	14.06	51	12.75
Salty	37	17.78	36	18.75	73	18.25
Spicy	40	19.23	28	14.58	68	17.00
Sweet and Salty	59	28.36	54	28.12	113	28.25
All	48	23.07	47	24.47	95	23.75

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Journal of Natural Resource and Development 7(1,2):64-65, 2012

INCIDENCE OF REPEAT BREEDING IN CATTLE OF ALLAHABAD UTTAR PRADESH, INDIA

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ABSTRACT

The previous breeding histories of cattle presented with infertility problems were noted from the records maintained at three different institutes of Allahabad, Uttar Pradesh. A total of 1061 breedable cattle were analysed to calculate the total incidence of repeat breeding during last one year. The overall incidence rate of repeat breeding was 9.10 per cent. The highest incidence was recorded at OPD, Veterinary Hospital, Bara, Allahabad (16.73%), followed by Veterinary Hospital, Bahariya (15.34%) and KVS Hospital, Bhardwaj Sadar, Allahabad (4.04%).

Keywords: *Cattle, incidence, repeat breeding.*

Allahabad is the eastern part of Uttar Pradesh. Infertility problems are frequently encountered and needs a proper recording and reporting. Repeat breeding defined as cow's failure to conceive from three or more regularly spaced services in the absence of detectable abnormalities, is a costly problem for the dairy farmer. The overall incidence of repeat breeding was 12.02% in Patna, Bihar. Dhabale *et al.*, (1996) reported an overall incidence of 17.79% at Military Dairy Farm, Bareily. Pargaonkar and Bakshi (1987) reported an incidence of 8.00% in crossbred cows. To elucidate the occurrence of repeat breeding in Allahabad and to serve as an early warning for the farmers, the present study was undertaken from July 2010 to June 2011.

MATERIALS AND METHODS

The present investigation was carried out at Out Patient Department (OPD), Veterinary Hospital, Bara Allahabad (Hospital-1), Veterinary Hospital Bahariya, Allahabad (Hospital-2) and Key Village Scheme (KVS) Hospital, Bhardwaj Sadar, Allahabad (Hospital-3). A total of 1021 cases were presented, out of this a total of 93 cows were repeat breeders.

RESULTS AND DISCUSSION

Hospital-1 recorded the highest number of repeat breeder cases (16.73%) followed by Hospital-2 (15.34%) and Hospital-3 (4.04%). The overall incidence of repeat breeding at these three Hospitals was 9.10 percent (Table 1), which is in agreement with earlier findings of Kumar *et al.*, (2006) and Pargaonkar and Bakshi (1987). However, low incidence rate of 4.2% was recorded by Narladkar *et al.*, (1994). The variations might be due to the difference in geographical location, agroclimatic zones and individual variations. The highest numbers of repeat breeding cases were recorded in Hospital-1 and the lowest were in Hospital-3. This might be due to the fact that majority of the repeat breeder cases need proper evaluation with latest diagnostic tools and treatment with modern reproductive approaches, which are made available at the Hospital-1.

CONCLUSION

In the comparison of the results of three Hospitals in Allahabad Uttar Pradesh in the repeat breeder cows, the variations might be due to the

Table 1: Incidence of Repeat breeding in cattle during the last one year (June 2010- May 2011)

Place of study	Animals presented for AI	Repeat breeders	Repeat breeding percentage
1. OPD, Veterinary hospital Bara Allahabad	251	42	16.73 %
2. OPD, Veterinary hospital Baharlya	176	27	15.34 %
3.K.V.S.Bhardwaj sadar Allahabad	594	24	4.04 %
Overall incidence (Grand total)	1021	93	9.10 %

difference in geographical location, agroclimatic zones and individual variations. The highest numbers of repeat breeding cases were recorded in Hospital-1 and the lowest were in Hospital-3.

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Journal of Natural Resource and Development 7(1,2):66-68, 2012

FORMULATION AND NUTRITIONAL COMPOSITION OF VALE ADDED PRODUCT PREPARED USING FLAX SEED FLOUR IN WHEAT FLOUR

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ABSTRACT

Flax Seed Flour were incorporated in wheat flour recipes viz- *Puri* with one control (T_0) and four treatments for each products T_1, T_2, T_3 and T_4, different percentage incorporation levels with Flax seed flour for one product using their standard ingredients and method of preparation. Sensory evaluation of the prepared products was done by 9 point hedonic scale. The nutritive value of prepared food products was calculated by using the food composition table. Result showed that based on the expert panel evaluation of product, showed that the highest overall acceptability was found in T_4 (40%) *Puri*. All the experimental prepared products were fond to be acceptable. Significant Difference (Pd"0.05) in flavour and taste, body and texture and colour and appearance between various treatment combinations was found. The prepared products were found to be low in calories and carbohydrate but high in fibre, calcium, iron, phosphorus, sodium potassium and carotene content. It was concluded from the results that the products formulated by incorporation of Flax seed flour in wheat flour at different level can improve the nutritional quality of products as well as variety in the diet.

***Keywords:** Wheat flour, flax seed flour*

Wheat flour is an excellent source of complex carbohydrates. In addition, wheat flour contains B-vitamins, calcium, iron, magnesium, phosphorus, potassium, zinc, minimal amounts of sodium and other trace elements.

Flax (also known as common flax or linseed) (binomial name: *Linum usitatissimum*) is a member of the genus *Linum* in the family Linaceae. Flaxseed, called ("Tisi" or "Alsi") in northern India, has been roasted, powdered and eaten with boiled rice, a little water, and a little salt since ancient times in the villages. Flax seeds come in two basic varieties: (1) brown (2) yellow or golden. Most types have similar nutritional characteristics and equal numbers of short-chain omega-3 fatty acids. The exception is a type of yellow flax called solin (trade name Linola), which has a completely different oil profile and is very low in omega-3 FAs. A study done at Duke University suggests that flaxseed may stunt the growth of prostate tumors, although a meta-analysis found the evidence on this point to be inconclusive.

MATERIALS AND METHODS

The present study was conducted in the Nutrition Research Laboratory of Foods and Nutrition Department, Ethelind School of Home Science, Sam Higginbottom Institute of Agriculture Technology and Sciences, (Deemed-to-be-University), Allahabad.

Procurement of Raw Materials: The required materials i.e. flax seed and other row materials were collected from local market of Allahabad city.

Method and preparation of flour (Srivastava 2003):
Flow chart for the preparation of Flax Seed Flour

Flax Seed
↓
Washing & Cleaning (to remove the dirt)
↓
Sun drying (2 days)
↓
Roasting
↓
Grinding
↓
Flax Seed Flour

Detail of control and treatments:

Organoleptic Evaluation of the Prepared Products: Freshly Prepared Products *Flax Seed Puri* were served to taste panel members consisting of 5 experienced persens. The 9 point hedonic scale Performa as suggested by **American *et al.* (1965).**

Calculation of Nutritive Value of Prepared Products:

The nutrient compositions as available in Gopalan *et al.*, (2007) publication were used for calculating nutritive value of the products. Protein, Fat, Carbohydrate, Energy, fiber, iron, calcium, Phosphorus, Sodium Potassium and Carotene of the control and enriched products were thus assessed by Calculation.

Formula:

Nutrient/100g of product =

$$\frac{\text{Ingredient used (g)} \times \text{Nutritive value of Ingredient}}{100}$$

Statistical Analysis of the Products:

After tabulating the data obtained from sensory evaluation was statically analysed by using two way Analysis of Variance techniques. Significant difference between the treatments was determined by using CD (critical difference) test.

Table 1: Treatments and Replication of *Flax seed flour Puri.*

Treatments / Products	T0	T1	T2	T3	T4	Replications
Whole Wheat Flour	Control	90%	80%	70%	60%	5
Lotus Stem Flour	-	10%	20%	30%	40%	5

RESULTS AND DISCUSSION

The entire experiment was undertaken to prepare enriched products i.e. healthy and nutritious product – *Flax Seed Puri* using different Flours combinations. Results related to formulation and standardization of healthy and nutritious products i.e sensory evaluation and nutritional composition have been presented and discussed in this chapter.

Organoleptic Evaluation of the Prepared Products:

Table shows significant result, it is desirable to compare all possible combinations of two treatments at a time for which CD test has been applied. Difference between two treatments mean have been compared against the CD value.

Flax seed Puri, the sensory score of the sensory score of T_4 (40 percent) was best regarding the overall acceptability followed by T_3 (30 percent) and there was significant difference between the two. T_2 (20 percent) was found to be more acceptable than T_1 (10 percent) and T_0 (control).

Table 3 shows the nutrient content of the prepared product *Flax Seed Puri* with or without incorporation of Flax Seed Flour (Flax Seed Flour and Whole Wheat Flour).

The Nutrient Estimation showed that T_4 (40 percent) has the maximum Protein, Fat, Fibre, Energy, Calcium, Phosphorus, Iron, Sodium and Potassium content and T_0 (Control) has the minimum Protein, Fat, Fibre, Energy, Calcium, Phosphorus, Iron, Sodium and Potassium content in *Flax Seed Flour Puri.* The Carbohydrate estimation for *Flax Seed Flour Puri* shows that T_0 (control) has the maximum Carbohydrate content for each product respectively.

CONCLUSION

From the findings of the study undertaken, it was concluded that Flax Seed Flour can be successfully incorporated with Wheat Flour to enhance the sensory and nutritional properties of the products were made there after. Regarding the sensory scores of the prepared products were highly acceptable in terms of taste and flavour, body and texture, colour and appearance and overall acceptability when compared with control. Nutrients Composition of prepared products showed that low carbohydrate contents as compared to control. The amount of the energy, protein, fat, fiber, calcium, iron, sodium, potassium and carotene content were increase as the incorporation level increased.

Table 2: Average sensory scores of different parameters in control and treated sample of *Flax Seed Puri*.

Sensory characteristics/ treatment	Scores on 9 point hedonic scale			
	Colour and Appearence	Body and Texture	Taste and Flavour	Overall Acceptability
	Mean±S.E	Mean±S.E	Mean±S.E	Mean±S.E
T_0 (Control)	7.76 ± 0.104	7.52 ± 0.368	6.68 ± 0.230	7.18 ± 0.182
T_1 (10%)	7.88 ± 0.121	7.48 ± 0.351	6.88 ± 0.165	7.43 ± 0.181
T_2 (20%)	8.12 ± 0.133	7.82 ± 0.259	7.48 ± 0.155	7.83 ± 0.233
T_3 (30%)	8.4 ± 0.063	8.34 ± 0.190	8.22 ± 0.152	8.29 ± 0.199
T_4 (40%)	8.6 ± 0.097	8.74 ± 0.168	8.8 ± 0.122	8.67 ± 0.166
F Value	76.87^{S}	14.45^{S}	38.123^{S}	875.75^{S}
CD Value	0.118	0.466	0.432	0.059

Calculation of Nutritive Value of Prepared Products:

Table 3: Nutrient Composition (per 100g.) in control and treated sample of *Flax Seed Puri.*

Nutrients / Treatments	Protein (g)	Fat (g)	Fiber (g)	Carbohydrate (g)	Energy (Kcal)	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Carotene (µg)	Sodium (mg)	Potassium (mg)
T_0	5.78	34.14	0.905	59.00	538.19	25.14	169.23	2.36	70.95	9.52	150
T_1	6.15	36.06	2.11	50.05	547.19	35	182.90	2.40	71	10	173.71
T_2	6.51	37.99	3.32	48.12	556.19	44.85	196.57	2.44	71.04	10.47	197.42
T_3	6.90	39.91	4.53	46.19	565.19	54.71	210.19	2.48	71.09	10.9	221.14
T_4	7.28	41.84	5.98	44.26	574.19	64.57	223.90	2.52	71.14	11.42	244.85

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