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EFFECT OF IRRIGATION AND NITROGEN ON GROWTH AND YIELD OF FIELD PEA VARIETIES

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ABSTRACT

A field experiment was conducted during rabi season of 2008-09 at R.B.S. College Agriculture farm Bichpuri (Agra) to evaluate the effect of irrigation and nitrogen on growth yield of pea varieties. The experiment comprised of two irrigation, three nitrogen levels and two pea varieties was laid out in spilt-split plot design with four replicaions.The results revealed that the maximum value of growth characters, yield attributes and yields were recorded with the application of one irrigation than no irrigation. The biological, grain and straw yields increased by 25.9, 22.5 and 27.8 % with one irrigation over no irrigation, respectively. The growth parameters, yield attributes and yields increased significantly with the application of 15 kg N ha^{-1} over control. Although maximum values of these parameters were obtained with 30 kg N ha^{-1} but it was statistically at par with 15 kg N ha^{-1}. Application of 15 kg N ha^{-1} caused 13.9, 10.2 and 21.3% increase in biological, straw and grain yields, respectively over control. Significantly higher values of growth parameters, yield attributes and yields were obtained with variety Aparna than Pant P-13. Variety Aparna produced significantly more biological, grain and harvest index by 13.0, 9.9 and 1.30 % than that of Pant P-13,

Key Words: Growth, yields, irrigation, nitrogen, varieties, pea

INTRODUCTION

Pea (*Pisum sativum* L.) is the popular pulse crop throughout the world. Grain legumes fix atmospheric nitrogen (N) to the system and produce grain rich in protein while improving soil N for the succeeding crop. Irrigation plays an important role in raising yield potential of crop. Shortage of water is the most terrible constraint for agricultural development. Under this condition, demand to use the available water economically and expeditiously is unquestionable in India. In the field, soil water appears to be greater importance since it acts both directly on plant growth and function and indirectly by affecting other related factors such as aeration, soil impedance and soil temperature prevailing in the root zone (Sharma 2005). Acute shortage of irrigation water is adversely affecting crop production in general and pulse production in particular. Irrigation management is of special importance as the proper irrigation may bring 100-150 percent increase in the yield depending upon the soil type, winter rains and depth of the water table (Singh, 2001). Nitrogen plays a big role in all metabolic processes. It forms an important constituent of cell structure and is indispensable for the transfer of genetic information.. Cultivar plays a vital role in crop production. Any cultivar of pea before recommended for general cultivation for particular region must be judged for its potential, tolerance against disease, in general, and in particular responsiveness to added water and fertilizer and adaptability to different agro-climatic conditions. Thus, the value of stable and high yielding cultivar has been universally recognized as an important factor for boosting crop production. The new cultivars display improvements including disease resistance, plant architecture (standability), seed quality and yield, whilst there are also changes in flowering and maturity that could affect agronomic management. Since the irrigation and fertilizer management have a direct role in quantity and quality of yield, so the present study was carried out to find the effect of irrigation and nitrogen on growth and yield of pea - varieties in semi arid condition of Agra region.

MATERAILS AND METHODS

A field experiment was conducted during winter (*rabi*) season of 2008-09 at R.B.S. College, Agricultural Research Farm, Bichpuri, Agra (U.P.). The soil of the experimental field was sandy loam in texture, having pH 8.2, organic carbon 3.5 g ha^{-1}, available N (178 kg ha^{-1}), available P_2O_5 (24 kg ha^{-1}) and K_2O (112 kg ha^{-1}). The treatments comprised two irrigation (no irrigation and one irrigation), three levels of nitrogen (0, 15 and 30 kg ha^{-1}) and two varieties (Aparna and Pant P-13) were tested in split-split plot design, keeping irrigation in main plot, N levels in sub plot and varieties in sub-sub plot with four replications. Urea, singlesuper phosphate and muriate of potash were used as the source of N, P_2O_5 and K_2O, respectively. Half dose of N as per treatment and full dose of P_2O_5 and K_2O were applied at the time of sowing as basal. The remaining half dose of N was top dressed after 40 days after sowing.

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Pea cultivars were sown on 5 Nov, 2008 using seed rate of 100 kg ha^{-1} and row spacing 30 cm apart. All improved packages of practices were followed to raise the crop. The observations were recorded on growth and yield attributes and yields at harvest.

RESULTS AND DISCUSSION

Growth parameters

The data (Table 1) indicated that plant height, primary branches, dry matter accumulation $plant^{-1}$, length of root, weight of root, effective nodules $plant^{-1}$ and weight of nodules $plant^{-1}$ were significantly higher with one irrigation over no irrigation. The corresponding increases in growth characters with one irrigation were 18.0, 21.6, 11.0, 16.2, 81.9, 11.6 and 71.8% over no irrigation, respectively. One time irrigation can contribute considerably towards chlorophyll content and root development due to more absorption of water from from the soil. These findings indicate that application of irrigation to pea crop favours root development and promotes crop growth. Beneficial effect of irrigation on growth parameters have also been reported by Singh *et al.* (2007).

Table 1: Effect of irrigation, nitrogen and varieties on growth characters of pea

Treatments	Plant height (cm)	Primary branches	Dry matter accumulation (g)	Length of root (cm)	Weight of root (g)	Nodules $plant^{-1}$	Weight of nodules $plant^{-1}$ (g)
Irrigation							
No irrigation	22.48	3.42	26.45	11.62	0.144	22.15	0.028
One irrigation	26.52	4.16	29.37	13.50	0.262	24.73	0.048
SEm±	0.65	0.11	0.58	0.36	0.025	0.52	0.004
C.D. (P=0.05)	2.93	0.50	2.61	1.62	0.113	2.34	0.018
N (kg ha^{-1})							
0	20.75	3.40	26.54	11.73	0.141	22.25	0.031
15	26.30	3.96	28.54	12.95	0.233	24.02	0.041
30	26.42	4.01	28.68	13.00	0.235	24.05	0.042
SEm±	0.62	0.10	0.56	0.35	0.021	0.48	0.003
C.D. (P=0.05)	1.91	0.31	1.72	1.08	0.065	1.48	0.009
Varieties							
Aparna	25.06	3.93	28.96	12.75	0.212	24.32	0.042
Pant P-13	23.94	3.65	26.88	12.37	0.194	22.56	0.034
SEm±	0.60	0.93	0.52	0.35	0.024	0.46	0.002
C.D. (P=0.05)	NS	0.27	1.54	NS	NS	1.37	0.006

The data (Table 1) clearly indicated that increasing levels of N increased all growth characters up to highest levels of N (30 kg N ha^{-1}) over control, but this was found statistically at par with 15 kg N ha^{-1} in respect of growth characters. This might be due to vital role of nitrogen in the plant. It is a constituent of protoplasm, chlorophyll "a", "b" and nucleic acids. One of the main functions of nitrogen is the initiation of meristematic activity of plant. The cell division and enlargement are also accelerated by ample supply of nitrogen. Thus, the growth of plant by and large depends on nitrogen. The present findings are in consonance with those of Pandey *et al.* (2005).

Variety Aparna produced significantly higher number of primary branches, dry matter accumulation $plant^{-1}$, nodules $plant^{-1}$ and weight of nodules $plant^{-1}$ than that of Pant P-13. The differential behavior of the cultivars in respect of growth parameters could explain solely by their genetic constitution and adaptability of soil and climatic conditions. However, variety Aparna had higher plant height, length of root and weight of root and these were found 4.7, 3.1 and 9.2% respectively more than Pant P-13.These results are in conformity with the findings of Jan *et al.* (2007). The effects of varieties on plant height, length of root and weight of root were not found significant.

Yield attributes

The data (Table 2) showed that the application of irrigation significantly increased the yield attributing characters of pea over no irrigation. The yield attributing traits viz. pods $plant^{-1}$, weight of pods $plant^{-1}$, length of pod, grains $plant^{-1}$, weigh of grains $plant^{-1}$ and grains pod^{-1} increased with one irrigation by 17.3, 18.7, 21.7, 25.5, 19.7 and 7.0% respectively over no irrigation. Irrigation did not affect the weight of grains pod^{-1} and test weight significantly. However, relatively higher weights of grains pod-1 and test weight were obtained with one irrigation. This might be due to the adequate availability of soil moisture for prolouged period.Similar effect was also seen by De *et al.* (2009).

Data revealed that N application had significant influence on yield attributes of pea over control. Application of 30 kg N ha^{-1} recorded higher pods $plant^{-1}$, weight of pods $plant^{-1}$, grains $plant^{-1}$, and grains pod^{-1} over 15 kg N ha^{-1} and control. But both the levels of N were at par in these respects. Data further revealed that maximum length of pod was obtained with 15 kg N ha^{-1} and this was found significantly superior over 30 kg N ha^{-1} and control. Application of 15 kg N ha^{-1} also recorded higher weight of grains $plant^{-1}$ and weight of grains pods $^{-1}$, which was found at par with 30 kg N ha^{-1}. Adequate supply of N helps in the increased production of larger dark green leaves due to proper meristematic activities in the cell. This turn helped the maximum utilization of sunlight and other growth factors which ultimately resulted in production of more photosynthates and translocation from leaves to reproductive parts. Yadav et al.(2012) reported similar results.Harvest Index (HI) denotes the proportion of economically produced part to the above ground biomass and varied significantly with nitrogen level.Application of 15 kg N ha^{-1} increased the harvest index by 3.0 and 3.4% over 30 kg N ha^{-1} and control, respectively. Similar results have been also reported by Yadav *et al.* (2012). The yield attributing characters of pea were significantly affected with pea varieties. Variety Aparna gave significantly higher pods $plant^{-1}$, weight of pods $plant^{-1}$, length of pod, grains $plant^{-1}$, weight of grains $plant^{-1}$, weight of grains pod^{-1} and number of grains pod^{-1} by 9.7, 10.1, 10.0, 18.6, 9.2, 8.6 and 3.1 % than that of Pant P-13, respectively. This result agrees with those of Shukla *et al*. (2009). Pea varieties did not affect the harvest index significantly. However, variety Aparna recorded higher harvest index (34.37%) than Pant P-13 (33.07 %).

Table 2: Effect of irrigation, nitrogen and varieties on yield attributes of pea

Treatments	Pods $plant^{-1}$	Wt. of pods $plant^{-1}$	Length of pod (cm)	Grains $plant^{-1}$	Wt. of grains $plant^{-1}$ (g)	Wt. of grains pod^{-1} (g)	Grains pod^{-1}	Test weight
Irrigation								
No irrigation	18.38	23.88	4.34	60.14	21.50	1.24	3.27	203.60
One irrigation	21.56	28.34	5.28	75.46	25.74	1.18	3.50	211.18
SEm±	0.61	0.85	0.18	2.25	0.65	0.04	0.05	6.48
C.D. (P=0.05)	2.75	3.83	0.81	10.13	2.92	NS	0.22	NS
N (kg ha^{-1})								
0	18.52	25.03	4.40	59.35	22.52	1.14	3.30	205.18
15	20.55	27.62	4.98	71.41	25.06	1.25	3.43	212.23
30	20.84	28.64	4.05	72.64	24.28	1.24	3.43	206.03
SEm±	0.58	0.82	0.15	2.18	0.64	0.03	0.04	5.16
C.D. (P=0.05)	1.79	2.53	0.46	6.72	1.97	0.09	0.12	NS
Varieties								
Aparna	21.42	27.36	5.04	73.58	24.66	1.26	3.24	209.18
Pant P-13	19.52	24.86	4.58	62.02	22.58	1.16	3.14	206.59
SEm±	0.56	0.80	0.14	2.15	0.62	0.03	0.04	4.58
C.D. (P=0.05)	1.66	2.38	0.42	6.38	1.84	0.09	0.10	NS

Yields

The data (Table 3) revealed that application of irrigation, nitrogen and varieties significantly increased yields (biological, grain and straw) of pea. The maximum yields (biological, grain and straw) were obtained with one irrigation (I_1). This treatment was also found significantly superior to no irrigation with respect of yields of pea. The biological, grain and straw yields increased by 25.9, 22.5 and 27.8% with irrigation over no irrigation, respectively. All the yield attributing characters might be held responsible for higher yield of pea with one post sowing irrigation. Similar results were reported by Singh *et al*. (2007). The data (Table 3) indicated that the biological and straw yield increased significantly with the application of 15 kg N ha^{-1} over control. Although maximum biological and straw yield were obtained with 30 kg N ha^{-1} but this was found statistically at par with 15 kg N ha^{-1}. Grain yield of pea showed significant improvement with successive increase in nitrogen level only up to 15 kg N ha^{-1}. Application of 15 kg N ha^{-1} caused 13.9, 10.2 and 21.3% increase in biological, straw and grain yield, respectively over control. Increased grain yield due to N application could be ascribed to increased biomass production, improved harvest index and increased seed set with N fertilization. This increase in grain and biological yields due to N application may be attributed to the

fact that N is main yield limiting plant nutrient is semi-arid region ehere the soils are deficient in nitrogen. Applied N is reported to enhance the absorption of native as well as added N, P and K and there by improves over all growth and development of plants and ultimately the grain and straw yield. Positive effect of nitrogen on yields was reported by Singh *et al*. (2007) and Yadav *et al.* (2012).

Table 3: Effect of irrigation, nitrogen and varieties on yields of pea

Treatments	Biological yield (q ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
Irrigation				
No irrigation	45.54	15.22	30.32	33.42
One irrigation	54.82	18.64	36.18	34.00
SEm±	1.76	0.52	1.05	1.02
C.D. (P=0.05)	7.92	2.34	4.73	NS
N (kg ha^{-1})				
0	45.48	15.03	30.45	33.05
15	51.80	18.24	33.56	35.21
30	53.26	17.52	35.74	32.90
SEm±	1.70	0.47	0.98	0.73
C.D. (P=0.05)	5.24	1.45	3.02	2.25
Varieties				
Aparna	51.59	17.73	33.86	34.37
Pant P-13	48.77	16.13	32.64	33.07
SEm±	0.92	0.45	0.85	0.40
C.D. (P=0.05)	2.74	1.34	NS	1.28

There were significant variations in biological, straw and grain yields between the two varieties of pea. Variety Aparna produced significantly more biological, grain and harvest index by 13.0, 9.9 and 1.3 % than that of Pant P-13, respectively. The difference in yields between pea cultivars may be due to variation in their production capacity of grain and biological yield. In pea variety Aparna, increased root volume and chlorophyll content could be major contributor towards an increase in yields. These results confirm the findings of Shukla *et al.* (2009). Pea varieties did not affect the straw yield significantly; however, higher straw yield was noted with variety Aparna which was 3.7% more than Pant P-13. Based on the study, it is concluded that Aparna genotype of pea should be grown with one irrigation and 15 kg N ha^{-1} for greater growth and productivety in alluvial soil of Agra region.

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