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Effect of spacing and fertilizer level on growth, seed yield and resultant seed quality in pea *(Pisum sativum* L.) cv. Bonneville

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Abstract: The treatments with four spacings (2.5, 5.0, 7.0 and 10 cm between plants and a uniform spacing of 40 cm between rows) and three levels of NPK fertilizers (80:60:50; 120:80:70 and 160:100:90 kg ha^{-1}) were imposed on seed crop of pea *(Pisum sativum* L.) cv. Bonneville. Observations were made on days to first flowering, plant height, number of pods plant^{-1}, pod yield plant^{-1}, number of seeds pod^{-1}, seed yield plant^{-1}, shelling outturn and 100 seed weight. All the parameters were significantly influenced by spacings and fertilizer levels. With every increased level of NPK fertilizer and spacing, generally these characters showed favourble response. Germination potential, seedling growth, vigour index, dry matter production, electrical conductivity, protein content and free amino acids of the resultant seeds also have positive association with increased fertilizer levels and spacing.

Keywords : *Pisum sativum* L., spacing, fertilizer level, seed yield, seed quality

Introduction

Improved agronomic practices play a major role in raising seed crops. Application of the major nutrients in required doses can improve the yield and quality of the resultant seed. Nitrogen at higher levels increased the cell division and cell differentiation and results in long growth phase leading to later flowering (Pandey *et al.* 1994). The enhancement of growth characters might be ascribed to the influence of nitrogen, which is the chief constituent of protein and an important component of amino acids, and co-enzymes, which are of considerable biological importance (Bakly, 1998). Similarly, optimum number of plants per unit area is also an important parameter in increasing the crop productivity. Wider spacing due to less plant population per unit area/and a closer spacing due to competitive effect gave lesser yield (Kacha *et al.* 1990). For getting higher yield of quality seeds, optimum plant density has to be fixed. The information available on this aspect in pea seed crop is megre and as such, specific recommendations for different agroclimatic conditions are lacking. The present investigation was therefore conducted to evolve optimum spacing and fertilizer level for seed crop of pea.

Materials and Methods

A field trail adopting factorial randomized block design was conducted at Nanjanadu farm. Horticultural Research Station, Ooty on November 1998. The soil of the experimental field was well drained and sandy loam type. Four different spacings of 2.5, 5.0, 7.5 and 10.0 cm between plants and three dose of NPK levels of 80:60:50; 120:80:60 and 160:100:90 kg ha^{-1} were given as treatments in all possible combinations with four replications. Uniform spacing of 40 cm was maintained between rows. Among the fertilizers, 50 per cent N and full dose of P and K were applied as basal and remaining 50 per cent N was applied as top dressing on 20 days after sowing. The recommended cultural and plant protection measures were followed. Irrigations were given as and when necessary. In ten randomly marked plants in each replication, observations on days to first flowering, plant height, number of pods plant^{-1}, pod yield

Table 1. Effect of spacing and fertilizer level on growth characters and yield of pea seed crop

Treatments	Days to first flowering	Plant height (cm)	*Number of pods plant^{-1}	*Pod yield plant^{-1} (g)	*Number of seeds pod-1	Seed yield plant^{-1}(g)	Shelling outturn (%)	100 seed weight (g)
Spacing								
2.5 cm	60.08	145.66	10.07	16.78	5.2	6.73	62.27	20.05
5.0cm	60.25	145.30	10.91	18.17	5.3	12.76	63.08	23.17
7.5 cm	58.60	147.20	13.96	23.26	5.5	16.94	62.92	23.26
10cm	58.93	154.58	17.44	29.05	5.4	20.83	65.99	23.47
CD (P=0.05)	1.63	2.62	1.56	1.99	NS	1.20	1.31	0.54
Fertilizer (NPK kg ha^{-1})								
80:60:50	56.96	144.50	12.39	20.65	4.7	12.49	63.47	21.36
120:80:70	59.56	148.17	13.21	22.01	5.4	14.77	63.44	22.50
160:100:90	61.88	151.91	13.68	22.79	5.8	15.67	63.87	23.36
CD (P=0.05)	1.88	2.41	1.32	1.81	0.31	1.04	NS	0.62

* Interaction not significant

plant^{-1}, number of seeds pod^{-1}, seed yield plant^{-1} and shelling outturn were recorded. Shelling outturn was calculated using the formula as (total seed yield/total pod yield) x 100 (Ravichandran and Ramaswami, 1992). 100 seed weight was determined by weighing the mean weight of eight samples containing 100 seeds (ISTA, 1996). The seed samples from each replication were then analysed for its physiological and biochemical characters. Standard germination test was performed in sand medium using 4 x 100 seeds in a germination room maintained at 25±2°C temperature and 90±3% relative humidity. After 7 days, the seedlings were evaluated and normal seedlings were counted and expressed in percentage germination (ISTA, 1996). Dry matter production and Vigour index (root length and shoot length x percentage germination) (Abdul-Baki and Anderson, 1973). Seeds of each replication were also analysed for the electrical conductivity of seed leachate (Presely. 1950), seed protein content (Ali-khan and Youngs, 1973) and free amino acids (Ching and Ching, 1964). The data were subjected to statistical analysis to test the significance of different treatments following the methods of Panse and Sukhatme(1985).

Results and Discussion

The effect of different spacing and NPK fertilizer level on growth characters and seed yield is shown in table 1. Plant height and days to first flowering showed a significant difference due to the treatments imposed. The application of higher levels of NPK registered higher plant growth and late flowering. The enhancement of growth characters might be ascribed to the influence of nitrogen, which is the chief constituent of protein and an important component of ammo acids, and co-enzymes, which are of considerable biological importance Bakly, 1974). The results are/ In conformity with those reported by

Table 2. Effect of spacing and fertilizer leveLon-the resultant seed quality

Treatments	Germination (%)	Vigour Index	Drymatter Production (mg 10 seedlings^{-1})	Electrical conducti-vity (dSm^{-1})	Protein content (%)	Free amino (ug)
Spacing > cm						
2.5 cm	82	1789	224	1.462	18.3	82.0
5.0 cm	84	2108	234	1.373	19.9	77.5
7.5 cm	83	2037	226	1.368	19.9	74.9
10 cm	88	2291	234	1.258	20.1	72.9
CD (P=0.05)	1.19	42.54	3.19	0.04	1.91	0.97
Fertilizer (NPK kg ha^{1})						
30:60:50	84	1986	224	1.406	19.2	78.5
120:80:70	84	2051	231	1.375	19.6	76.2
160:100:90	85	2260	234	1.319	20.0	75.8
CD (P=0.05)	NS	22.67	2.76	0.04	0.96	0.84

Magalheas and Giordano (1989) and Tripathi *et al.* (1991) in pea seed crop. Nitrogen at higher levels increased the cell division and differentiation and results in long growth phase leading to delayed flowering (Pandey *et al.* 1994).

Number of pods plant^{-1}, pod yield plant^{-1} and seed yield plant^{-1} were registered the highest at 160:100:90 kg NPK ha^{-1} and wider spacing of 10 cm between plants. Shelling outturn and 100 seed weight were also high at this combination. It might be attributed that wider spacing provides more opportunity for proper growth and development of individual plants by making available more of. solar radiation, plant nutrients, space and other growth promoting factors (Jain *et al.* 1990) and possibly due to more number of branches, leaf area and dry matter production per plant and an efficient translocation of photosynthates into sink (Jadhav *et al.* 1994). It has been suggested that high plant density reduces flower formation due to high percentage of flower abortion because of inter and intra plant competition for light, space, nutrients, moisture and metabolites (Rhoda, 1989). This may be the reason for the reduced plant height, number of pods plant^{-1}, pod yield plant^{-1}, seed yield plant"^{1} in the closely spaced plants in the present investigation.

The 100 seed weight of 23.36 g recorded for the seeds from higher NPK fertilizers of 160:100:90 kg ha^{-1} was significantly higher than those of 21.36 g recorded in the 80:60:50 kg ha^{-1}. Improvement of seed weight resulting from increased fertilizer application was also reported by Singh and Dixit (1989). However Ganagasaran and Giri (1990) and Joshi *et al.* (1991) did not find such positive response to graded dose of fertilizer.

The germination percentage of the resultant seeds, seedling vigour as reflected by the root

and shoot length as well as computed vigour (VI) were significantly higher for the seeds from wider spacing (10 cm between plants) and higher fertilizer levels (160:100:90 kg NPK ha^{-1}) (Table 2). Electrical conductivity and free amino acids of the seed leachate was lesser and protein content was higher in the resultant seeds obtained the same combination. The results are in conformity with the findings of Pyzik *et al.* (1987) and Ravichandran and Ramasami, 1992. Thus, it could be concluded that wider spacings of 10 cm between plants and increased fertilizer level of 160:100: 90 kg NPK ha^{-1} can be used to produce high yield of quality pea seeds.

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