



Short Note

Effect of split application of nitrogen on productivity, profitability and nitrogen use efficiency in garden pea (*Pisum sativum* L.) under dry temperate conditions of Himachal Pradesh

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Abstract

A field experiment comprising of six treatments viz. N0 (control), N20 (20 kg N/ha as basal), N40 (40 kg N/ha as basal), N20+20 (40 kg N/ha in two equal splits, half as basal and another half as top-dressing at 30 DAS), N60 (60 kg N/ha as basal) and N30+30 (60 kg N/ha in two equal splits) was conducted at Highland Agricultural Research and Extension Centre, Kukumseri during summer 2013 to study the effect of split application of nitrogen on growth, yield, economics and nitrogen use efficiency in garden pea. N at 60 kg/ha in splits gave taller plants while the shorter plants were under control. Basal application of 40 kg N/ha proved to be the best treatment for increasing productivity and profitability of garden pea in cold desert region of Himachal Pradesh. The highest dry matter production (5166 kg/ha) was recorded at N40. Maximum dry matter efficiency (0.83%/day), unit area efficiency (4.31g/m²/day), green pod weight (4.3g/pod) and productivity (43.13 kg/ha/day) were recorded at N40. The highest green pod yield (3666 kg/ha) was at N40 which was 120 and 62.9% higher over N0 and N20, respectively. Maximum nitrogen use efficiency (50 kg green pod/kg N), gross returns (99150/ha), net returns (62859/ha), B:C ratio (2.73) and profitability (Rs. 740/ha/day) were also at N40. There was no benefit of using N in splits in pea in this drier tract of the state.

Key words: Nitrogen, nitrogen use efficiency, productivity, profitability, garden pea.

The dry temperate region comprising of Lahaul & Spiti, Kinnaur and Bharmaur and Pangi areas of Chamba district of Himachal Pradesh, is an important vegetable growing region (Anonymous 2012; Singh *et al.* 2015; Kumar *et al.* 2015; Singh and Chaudhary 2016). It constitutes about 42% of the total geographical area of the state. Garden pea (*Pisum sativum* L.) is an important off-season cash crop vegetable of dry temperate region. It is a major source of income for the farmers as it fetches higher price due to its good aroma, sweetness and freshness. It is a cool season, self pollinated and hardy tendril climbing plant. It is rich in protein, vitamins A, B and C and minerals (Baloch 1994). Fertilizers are kingpins in increasing productivity of peas (Chadha *et al.* 2004). However, imbalanced application of fertilizers is one of

major reasons for low crop productivity and thereby profitability in the region. In dry temperate region, crop is generally raised using frequent irrigation. Therefore, nitrogen is also applied as top dressing by the farmers for enhancing garden pea yield. Keeping these facts in mind, the present investigation was undertaken to study the effect of split application of nitrogen on productivity, profitability and nitrogen use efficiency in garden pea in dry temperate region of Himachal Pradesh.

The field experiment was conducted during summer 2013 at Kukumseri (32° 44' 55" N latitude, 76° 41' 23" E longitude and 2672 m above the mean sea level). The climate was extremely cold and heavy snowfall occurs during winter. Single cropping season was prevailing in the region which

starts from April to September or early October when the mean minimum and maximum temperature ranges from 12 to 24°C. There is negligible rainfall followed by high light intensity and low humidity. The soil of the experimental site was sandy loam in texture and acidic in reaction with 11.1 g OC/kg soil, 247 kg available N/ha, 31 kg available P/ha and 289 kg available K/ha. Soils were shallow in depth and loose in texture resulting in poor water holding capacity. The experiment was laid out in randomized block design with six treatments viz. N₀ (control), N₂₀ (20 kg N/ha as basal), N₄₀ (40 kg N/ha as basal), N₂₀₊₂₀ (40 kg N/ha in two equal splits, half as basal and another half as top-dressing at 30 DAS), N₆₀ (60 kg N/ha as basal) and N₃₀₊₃₀ (60 kg N/ha in two equal splits) and three replications. Phosphorus and potassium were applied at 60 kg P₂O₅ and 60 kg K₂O/ha, respectively as basal application. N, P and K were supplied through urea, single super phosphate and muriate of potash, respectively. Garden pea cv Azad P-1 was sown on 4th June, 2013 at 45 cm inter-row spacing with a seed rate of 100 kg/ha. Seed was treated with bavistin at 2.5 g/kg seed. Pendimethalin was applied (1.35 kg/ha in 750 l of water/ha) within 48 hours of sowing for the control of weeds. Snowmelt water, the only source of irrigation was used to irrigate garden pea through sprinklers. The crop was harvested on 29th August, 2013. Other package of practices recommended for the region was followed. Plant height, plant stand, dry matter production, green pod weight and green pod yield were recorded and

productivity (kg/ha/day), dry matter efficiency (DME, % economic product/day), unit area efficiency (UAE, g/m²/day), nitrogen use efficiency (NUE, kg green pod yield/kg N), cost of cultivation, gross returns, net returns, B:C ratio and profitability were computed after the harvest of the crop. Statistical differences between treatments were tested with Fisher's least significant difference (P=0.05) test (Fisher and Yates 1949) using analysis of variance for randomized block design as described by Panse and Sukhatme (1967).

Plant height was significantly influenced due to nitrogen application (Table 1). It increased with increase in nitrogen up to 20 kg N/ha. Nitrogen levels resulted in similar plant height. However, 60 kg N/ha in splits has an edge in influencing the crop height. Number of plants per square meter was not affected significantly due to N application. Dry matter production increased significantly with an increase in nitrogen level up to 40 kg N/ha. Application of 20 (basal), 40 (basal), 40 (two splits), 60 (basal) and 60 (two splits) kg N/ha resulted in 65, 93.8, 81.2, 87.5 and 88.8% higher dry matter production over control treatment. Application of 40 (basal) and 40 (two splits) kg N/ha gave 17 and 9.4 per cent higher dry matter production than 20 kg N/ha, respectively. However, N₄₀ and N₆₀ produced similar crop dry matter. Split application of N did not have any benefit in influencing crop dry matter. Maximum dry matter efficiency was recorded with basal application of 40 kg N/ha while minimum dry matter efficiency was at N₂₀. Like dry

Table 1. Effect of levels and methods of nitrogen application on growth, yield attribute, yield and nitrogen use efficiency

Treatment	Plant height (cm)	Plants/m ²	Dry matter production (kg/ha)	Green pod weight (g)	Green pod yield (kg/ha)	Productivity (kg/ha/day)	DME (%/day)	UAE (g/m ² /day)	NUE (kg green pod/kg N)
N ₀ (control)	23.1	56	2666	3.2	1666	19.60	0.74	1.96	-
N ₂₀ (basal)	37.9	55	4416	4.0	2250	26.47	0.60	2.65	29.2
N ₄₀ (basal)	38.2	49	5166	4.3	3666	43.13	0.83	4.31	50.0
N ₂₀₊₂₀ (split)*	38.1	57	4833	4.0	3083	36.27	0.75	3.63	35.4
N ₆₀ (basal)	37.8	52	5000	4.1	3116	36.66	0.73	3.67	24.2
N ₃₀₊₃₀ (split)*	41.7	48	5033	4.3	3000	35.29	0.70	3.53	22.2
SE m ±	1.7	3.8	235	0.2	146	-	-	-	-
CD (0.05)	5.3	NS	738	0.6	455	-	-	-	-

*½ N as basal and ½ N as top dressing at 30 days after sowing

matter efficiency, maximum unit area efficiency was also noted at N₄₀ but minimum was in control treatment (Table 1). Nitrogen plays a key role in increasing vegetative growth while phosphorus and potassium improve root growth and seed quality, respectively. Taller plants and higher dry matter production, dry matter efficiency and unit area efficiency might be due to better availability of nutrients at critical growth stages. Saimbhi and Grewal (1986), Subhan (1991), Ali *et al.* (2001), Kakar *et al.* (2002), Gul *et al.* (2006), Achakzai (2012) and Singh and Chaudhary (2016) also reported better growth with nitrogen application.

Green pod weight increased significantly up to 20 kg N/ha. Maximum green pod weight was recorded under basal application of 40 kg N/ha while the lowest green pod weight was in the control treatment. Green pod yield increased significantly up to 40 kg N/ha. N at 60 kg/ha produced significantly lower green pod yield than at 40 kg/ha. Application of 20 (basal), 40 (basal), 40 (two splits), 60 (basal) and 60 (two splits) kg N/ha resulted in 35, 120, 85, 87 and 80%, respectively higher green pod yield over control. Green pod yield under 40 (basal), 40 (two splits), 60 (basal) and 60 (two splits) kg N/ha was 63, 19, 18 and 22%, respectively, higher over 20 kg N/ha. Productivity showed increasing trend with an increase in the level of nitrogen up to 40 kg N/ha, afterwards it declined. Split application of N at 40 kg N/ha had lower yield than its whole basal. This clearly indicated that split application is not at all required in pea. Higher green pod yield at 40 kg N/ha might be attributed to the significant influence of nitrogen on translocation of nutrients and dry matter accumulation during reproductive stage which in turn

improved growth and yield attributes and ultimately yield. Saimbhi and Grewal (1986), Pochauri *et al.* (1991), Subhan (1991), Verma and Saxena (1995), Yadav (1996), Ali *et al.* (2001), Kakar *et al.* (2002), Achakzai and Bangulzai (2006) and Gul *et al.* (2006) also observed response of peas to nitrogen application.

Nitrogen use efficiency indicates increment in green pod yield per kg nitrogen applied in the field. Nitrogen use efficiency increased upto 40 kg N/ha. It showed decreasing trend with an increase in nitrogen level after 40 kg N/ha. Economical viability of any technology plays a key role in adoption of technology as farmers always prefer low cost and high profitable technology.

Considering these facts, the various economics parameters like cost of cultivation, gross returns, net returns, benefit cost ratio and profitability of treatments were computed (Table 2). Maximum gross returns, net returns, B:C ratio and profitability were obtained with basal application of 40 kg N/ha. Application of 20 (basal), 40 (basal), 40 (two splits), 60 (basal) and 60 (two splits) kg N/ha resulted in 187, 482, 356, 370 and 348% higher net returns and profitability over control (N₀). Basal application of 40 kg N/ha resulted in 482 and 103% higher net returns and profitability over 0 and 20 N/ha (basal), respectively. The higher returns under 40 kg N/ha could be attributed to increased green pod yield with application of fertilizers.

The present study revealed that basal application of 40 kg N/ha is the best treatment for increasing productivity and profitability of garden pea in dry temperate region of Himachal Pradesh. Results showed that split application of N was not beneficial over the whole basal.

Table 2. Effect of levels and methods of nitrogen application on economics

Treatment	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns Rs.(ha)	B:C ratio	Profitability (Rs./ha/day)
N ₀ (control)	35851	46650	10799	1.30	127.05
N ₂₀ (basal)	36071	67080	31009	1.86	364.81
N ₄₀ (basal)	36291	99150	62859	2.73	739.52
N ₂₀₊₂₀ (split)*	36491	85825	49334	2.35	580.40
N ₆₀ (basal)	36511	87320	50809	2.39	597.75
N ₃₀₊₃₀ (split)*	36711	85165	48454	2.32	570.05

*½ N as basal and ½ N as top dressing at 30 days after sowing

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