*Himachal Journal of Agricultural Research 36 (1): 33-36, 2010*

# Response of irrigation and phosphorus levels on seed yield attributes, seed yield and quality in garden pea (*Pisum sativum* L.)

**Gurpreet Singh Khalsa and Vidyasagar**
Department of Vegetable Science and Floriculture
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062, India.

**Abstract**

**A field experiment was conducted for three consecutive *rabi* seasons 2005-06, 2006-07 and 2007-08 at Palampur (humid sub-temperate climate) Himachal Pradesh to study the response of irrigation (I) and phosphorus (P) levels on seed yield and quality in garden pea var. Palam Priya. The treatment combinations comprised of five main-plot treatments (irrigation levels *viz.*, $I_1$: water seeding, $I_2$: $I_1$ + irrigation (1cm) at vegetative stage, $I_3$: $I_2$ + irrigation (1cm) at 75% flowering, $I_4$: $I_3$ + irrigation (1cm) at 75% podding and $I_5$: recommended 5cm irrigation at all the critical stages *viz.*, pre-sowing, vegetative stage, 75% flowering and 75% podding) and three sub-plot treatments (P-levels *viz.*, $P_1$, $P_2$ and $P_3$ 40,60 and 80kg $P_2O_5$/ha respectively). In all there were 15 treatment combinations. The field experiments were conducted in split-plot design with three replications. The irrigation treatment $I_4$ (water-seeding + 1cm irrigation along the rows at all the critical stages) was at par with recommended irrigation of 5cm depth at all the critical stages ($I_5$) for seed yield attributes *viz.*, pods/plant and seeds/pod, seed yield and quality traits. The highest P-level ($P_3$ @ 80kg $P_2O_5$/ha) was the best for seed yield, 100-seed weight, seed germination (%) and seed vigour index. The interaction between irrigation and phosphorus levels was significant for seed yield during 2006-07 only. The treatment combination $I_4P_3$ proved to be the best for seed yield.**

**Key words:** Irrigation, phosphorus, seed yield, seed quality, garden pea.

## Introduction

Garden pea (*Pisum sativum* L.) is one of the most important cool season vegetable crops grown throughout the world. In India, it is cultivated over an area of about 1.55 million ha with an annual production of 4.0 million tonnes (Anonymous, 2005). The area under garden pea crop in Himachal Pradesh is 16,348 ha with an annual production of 1,77,036 tonnes (Anonymous, 2006). With steady increase in acreage and production over the years, it has occupied the position of the most leading cash crop especially in high (zone III and IV) and mid hills (zone II), from where the green pods are available during the period April to October and they find ready market in the plains bringing remunerative returns to the growers. The main season garden pea varieties are sown during November (zone II and III) and March-June (zone IV) and inadequate soil moisture is usually a limiting factor in ensuring proper germination. Quality seed has been well recognized as the basic input in any production programme. Availability of water and nutrients especially phosphorus in legumes in acidic soils is of great significance in improving not only the seed yield but also the seed quality. Since scanty information is available regarding the response of limited irrigation alongwith P-fertilization in garden pea seed production under acidic soil conditions, the present investigation was, therefore, undertaken to supplement the same.

## Material and Methods

Field experiments were carried out during the *rabi* season of 2005 to 2008 at CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The soil of the experimental site was silty clay loam in texture, acidic in reaction (pH 5.9), medium in organic carbon (0.95%), available N (292.0kg/ha), $P_2O_5$ (17.2kg/ha) and $K_2O$ (263.2kg/ha) contents. The treatment combinations comprised of five main-plot treatments (irrigation levels *viz.*, $I_1$: water seeding, $I_2$: $I_1$ + irrigation (1cm) at vegetative stage, $I_3$: $I_2$ + irrigation (1cm) at 75% flowering, $I_4$: $I_3$ + irrigation (1cm) at 75% podding and $I_5$: recommended 5cm irrigation at all the critical stages *viz.*, pre-sowing, vegetative stage, 75% flowering and 75% podding) and three sub-plot treatments (P-levels *viz.*, $P_1$: 40kg $P_2O_5$/ha, $P_2$: recommended i.e. 60kg $P_2O_5$/ha and $P_3$: 80kg $P_2O_5$/ha). In all there were 15 treatment combinations. The field experiments were conducted in split-plot design with three replications. The experimental field/plots were prepared through tractor, power tiller and manual labour. The FYM, N and $K_2O$ doses were applied @ 20t/ha, 50kg/ha and 60kg/ha respectively before sowing. The phosphorus nutrient was applied through composite fertilizer (12:32:16 NPK) as per treatments whereas the remaining requirement of

N and $K_2O$ was calculated and met through urea and muriate of potash respectively. Garden pea seed (var. Palam Priya) were soaked in bavistin (0.1%) solution for 24 hours before sowing. Seed sowing was done in 2nd fortnight of November during each year manually by placing 30 seeds/row at equidistance. Chlorpyriphos @ 2.5ml/litre of water was sprayed within the rows before covering the seeds with soil to protect seed from soil born insects. Thinning was carried out to maintain the required plant population of 140 plants/plot around 35 DAS. The spacing between row to row was 45cm and plant to plant was 10cm. The total natural rainfall received during the crop seasons were 24.75cm, 48.59cm and 35.44cm during 2005-06, 2006-07 and 2007-08 respectively. Seed yield attributes were recorded on 10 randomly marked plants. Seed yield (g/plot or q/ha) was recorded after threshing. 100 seed weight (g) was recorded on electronic weighing balance. Seed germination (%) was recorded based on ISTA rules on the 8th day of incubation (Agrawal, 1986). Seed vigour index was calculated as per Abdul-Baki and Anderson (1973) as follows:

Seed vigour index = Seedling length x germination percentage.

## Results and Discussion

The seed yield attributes *viz.*, number of pods/plant, seeds/pod and seed yield (q/ha) were the highest with the irrigation level $I_5$ (recommended) but at par with $I_4$ (water seeding + limited irrigation of 1cm at all the critical stages) and both were superior as compared to the rest of the irrigation levels *viz.*, $I_1$, $I_2$ and $I_3$ during all the three years (Table 1). This shows that limited irrigation ($I_4$) is as good as recommended irrigation ($I_5$) for seed yield attributes and seed yield. The present findings are in close agreement to those of Rathi *et al.* (1995) and Reddy and Ahlawat (1998) who worked on field pea and chickpea crops respectively.

**Table 1. Seed yield attributes and yield of garden pea as influenced by irrigation and phosphorus levels**

| | Pod/plant | | | Seeds/pod | | | Seed yield (q/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2005-06 | 2006-07 | 2007-08 | 2005-06 | 2006-07 | 2007-08 | 2005-06 | 2006-07 | 2007-08 |
| Irrigation | | | | | | | | | |
| $I_1$ | 10.40 | 8.53 | 7.79 | 6.30 | 6.02 | 5.73 | 11.11 | 8.70 | 8.42 |
| $I_2$ | 10.40 | 8.74 | 8.46 | 6.39 | 6.27 | 6.28 | 11.06 | 9.44 | 8.56 |
| $I_3$ | 12.14 | 13.03 | 12.17 | 6.88 | 6.77 | 7.20 | 11.46 | 10.60 | 9.44 |
| $I_4$ | 12.73 | 13.13 | 13.78 | 7.48 | 6.71 | 7.46 | 13.29 | 13.65 | 13.20 |
| $I_5$ | 13.17 | 13.48 | 14.19 | 7.61 | 7.83 | 7.53 | 13.74 | 14.07 | 13.41 |
| CD (P=0.05) | 0.48 | 0.36 | 0.69 | 0.26 | 0.30 | 0.31 | 0.53 | 0.54 | 0.57 |
| Phosphorus | | | | | | | | | |
| $P_1$ | 10.91 | 10.42 | 10.79 | 6.31 | 6.61 | 6.58 | 11.44 | 10.29 | 10.05 |
| $P_2$ | 11.93 | 11.37 | 11.28 | 6.73 | 6.97 | 6.81 | 12.13 | 11.42 | 10.74 |
| $P_3$ | 12.47 | 12.36 | 11.75 | 6.88 | 7.18 | 7.13 | 12.83 | 12.18 | 11.04 |
| CD (P=0.05) | 0.44 | 0.45 | 0.40 | 0.23 | 0.21 | 0.27 | 0.27 | 0.38 | 0.37 |

As far as P-levels are concerned, seed yield attributes and yield were significantly higher with $P_3$ (80kg $P_2O_5$/ha) in all the three years except for seeds/pod and seed yield during 2005-06 and 2007-08 respectively where $P_2$ was at par with $P_3$. Phosphorus has a key role in rapid cell division and elongation in the meristematic regions, root development and proliferation and enhancing flowering, pod setting and seed formation. The present findings are in consonance to those of Bhatt *et al.* (2002) and Dass *et al.* (2005) while working on field pea and garden pea respectively. Irrigation x phosphorus interaction was significant only for seed yield during 2006-07 (Table 2).

**Table 2. Interaction effect of irrigation and phosphorus levels on seed yield (q/ha) in garden pea during 2006-07**

| Treatment | Seed yield (q/ha) | | |
|---|---|---|---|
| | Phosphorus (P) | | |
| Irrigation (I) | $P_1$ | $P_2$ | $P_3$ |
| $I_1$ | 8.28 | 8.57 | 9.26 |
| $I_2$ | 8.76 | 9.74 | 9.84 |
| $I_3$ | 9.92 | 10.79 | 11.08 |
| $I_4$ | 12.14 | 13.68 | 15.13 |
| $I_5$ | 12.33 | 14.31 | 15.58 |
| CD(P=0.05) to compare different phosphorus (P) levels at same level of irrigation (I) | | | 0.86 |
| CD(P=0.05) to compare different irrigation (I) levels at same or different levels of phosphorus (P) | | | 0.88 |

The highest P-level ($P_3$) gave significantly higher seed yield in comparison to $P_2$ and $P_1$ at irrigation levels $I_5$ and $I_4$ whereas P-levels $P_3$ and $P_2$ were at par at the irrigation levels $I_3$, $I_2$ and $I_1$. The irrigation level $I_4$ was at par with $I_5$ at all the levels of phosphorus. The treatment combination $I_5P_3$ resulted in the highest seed yield but it was only $I_4P_3$ combination which was at par with it.

Seed quality attributes *viz.*, 100 seed weight, seed germination (%) and seed vigour index are important not only for good germination but also for germination at a faster rate so as to ensure proper growth and development within a given period. Seed quality attributes were significantly influenced by different irrigation levels during all the three years except in 2006-07 where different irrigation levels were non-significant for the traits *viz.*, 100-seed weight and seed germination (Table 3). This may be attributed to more natural rainfall (48.59 cm) received by the crop during 2006-07 as compared to 2005-06 (24.75 cm) and 2007-08 (35.44 cm).

**Table 3. Seed quality attributes of garden pea as influenced by irrigation and phosphorus levels**

| | 100-seed weight (g) | | | Seed germination (%) | | | Seed vigour index | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2005-06 | 2006-07 | 2007-08 | 2005-06 | 2006-07 | 2007-08 | 2005-06 | 2006-07 | 2007-08 |
| Irrigation | | | | | | | | | |
| $I_1$ | 20.04 | 18.62 | 19.01 | 84.11 (9.17) | 80.78 (8.99) | 83.44 (9.13) | 1115.71 | 1197.01 | 1249.13 |
| $I_2$ | 20.11 | 18.89 | 19.16 | 83.78 (9.15) | 79.56 (8.92) | 84.22 (9.18) | 1196.84 | 1255.81 | 1326.23 |
| $I_3$ | 20.25 | 19.34 | 19.60 | 84.11 (9.17) | 80.33 (8.96) | 85.11 (9.23) | 1254.48 | 1320.79 | 1406.88 |
| $I_4$ | 21.79 | 19.64 | 19.89 | 86.89 (9.32) | 82.67 (9.09) | 86.67 (9.31) | 1374.03 | 1374.97 | 1450.81 |
| $I_5$ | 21.86 | 19.89 | 19.82 | 86.44 (9.30) | 82.78 (9.10) | 86.89 (9.32) | 1387.88 | 1378.93 | 1457.19 |
| CD (P=0.05) | 0.66 | NS | 0.44 | 1.90 (0.10) | NS | 1.03 (0.06) | 91.66 | 88.87 | 69.13 |
| Phosphorus | | | | | | | | | |
| $P_1$ | 20.35 | 18.98 | 19.04 | 83.80 (9.15) | 79.80 (8.93) | 84.20 (9.18) | 1207.63 | 1244.87 | 1295.95 |
| $P_2$ | 20.97 | 19.39 | 19.71 | 84.93 (9.22) | 81.60 (9.03) | 85.60 (9.25) | 1283.60 | 1333.78 | 1404.15 |
| $P_3$ | 21.10 | 19.46 | 19.74 | 86.47 (9.30) | 82.27 (9.07) | 86.00 (9.27) | 1306.13 | 1337.86 | 1434.05 |
| CD (P=0.05) | 0.56 | 0.35 | 0.26 | 1.05 (0.06) | 1.34 (0.07) | 0.90 (0.05) | 44.21 | 39.87 | 45.66 |

Values in parenthesis are square root transformed values

$I_5$ (recommended) and $I_4$ recorded significantly higher 100-seed weight and seed germination (%) over other irrigation levels ($I_1$, $I_2$ and $I_3$) and both were at par with each other during 2005-06 and 2007-08. $I_3$ was also at par with $I_4$ and $I_5$ during 2007-08 with respect to 100-seed weight. The recommended irrigation level $I_5$ gave the maximum seed vigour index and was at par with $I_4$ during all the three years and $I_3$ during 2006-07 and 2007-08 only which may be attributed to more rainfall during second (48.59 cm) and third (35.44 cm) years as compared to first year (24.75 cm). As far as P-levels are concerned, $P_3$ gave the maximum 100-seed weight, seed germination (%) and seed vigour index and was at par with $P_2$ and both were significantly superior to $P_1$ in all the

three years. $P_3$ was also significantly superior over $P_2$ during 2005-06 with respect to seed germination. Enhancement in 100-seed weight, germination percentage and seed vigour index in pea through P-nutrition was earlier reported by Amjad *et al.* (2004) and Prashant *et al.* (2006) who worked on pea and French bean respectively. I x P interactions were non-significant for seed quality traits during all the three years.

On the basis of the present investigation it may be concluded that under Palampur conditions (humid sub-temperate climate), the best irrigation schedule for garden pea seed crop is $I_4$ (water-seeding + irrigation (1 cm) at all the critical growth stages) alongwith P-level $P_3$ @ 80kg $P_2O_5$/ha to attain seed yield attributes, seed yield and seed quality at par with the recommended irrigation and phosphorus level.

## References


Abdul-Baki AA and Anderson JD 1973. Vigour determination in soybean seed by multiple criteria. Crop Sci. **13**: 630-33.

Agrawal RL 1986. *Seed Technology*. Oxford and IBH Publishing Company.

Amjad M, Anjum MA and Akhtar N 2004. Influence of phosphorus and potassium supply to the mother plant on seed yield, quality and vigour in pea (*Pisum sativum* L.). Asian J. Pl. Sci. **3**: 108-13.

Anonymous 2005. Food and Agricultural Organization; http://faostat.fao.org.

Anonymous 2006. *Area and Production of Vegetables in Himachal Pradesh*. Directorate of Agriculture (H.P), Shimla-5.

Bhatt MA, Sheikh FA and Salroo MY 2002. Response of field pea (*Pisum sativum* L.) to sowing dates and phosphorus levels under Kashmir valley conditions. Adv. Pl. Sci. **15**: 221-24.

Dass A, Patnaik US and Sudhishri S 2005. Response of vegetable pea (*Pisum sativum* L.) to sowing date and phosphorus under on farm conditions. Indian J. Agron. **50**: 64-66.

Prashant ND, Sajjan AS and Vyakarnahal BS 2006. Seed quality as influenced by levels of spacing and phosphorus in French bean (*Phaseolus vulgaris* L.). Karnataka J. Agric. Sci. **19**: 27-29.

Rathi GS, Sharma RS and Rajak RC 1995. Effect of irrigation schedule and phosphorus on yield attributes and yield of field pea (*Pisum sativum* L.). Indian J. Agron. **40**: 82-85.

Reddy NRN and Ahlawat IPS 1998. Response of chickpea (*Cicer arietinum*) genotypes to irrigation and fertilizers under late-sown conditions. Indian J. Agron. **43**: 95-101.


VIR SOFTECH