Himachal Journal of Agricultural Research 36 (2): 170-173, 2010

Effect of irrigation and phosphorus levels on earliness, biological and seed yield in garden pea (*Pisum sativum* L.)

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

(Manuscript Received: 14.06.2010; Accepted: 19.08.2010)

Abstract

A field experiment was conducted for three consecutive *rabi* seasons during 2005-06, 2006-07 and 2007-08 at the experimental farm of CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, to study the effect of irrigation and phosphorus levels on earliness, biological and seed yield in garden pea. The experiment consisted 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: 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 results revealed that water-seeding (0.43cm irrigation water applied within rows before sowing) proved better than pre-sowing irrigation of 5cm depth in early emergence of seedlings. Early flowering and early maturity were recorded in the treatments receiving limited irrigation water at one or more of the critical growth stages (I_1 to I_4) as compared to the recommended (I_5). The irrigation level I_4 alongwith P-level P_3 (80kg P_2O_5/ha) were the best for early flowering, seed maturity and biological and seed yields in garden pea.

Key words: Irrigation, phosphorus, earliness, seed yield, garden pea.

Introduction

Garden pea (*Pisum sativum* L.) is the most leading cash crop of Himachal Pradesh and is cultivated over an area of 16,348 ha with an annual production of 1,77,036 tonnes (Anonymous, 2006). Except the districts of Lahaul-Spiti and Kinnaur (zone-IV) and valley areas, its cultivation is primarily under rainfed/limited irrigation conditions. Inadequate soil moisture at sowing time in mid (zone-II) and high (zone-III) hills results in suboptimal plant stand thereby resulting in reduced green pod and seed yields. Phosphorus is known for healthy root development and early maturity and proves beneficial in better utilization of soil moisture and nutrients and ultimately enhances yield. Since the scope of increasing irrigation potential in the state is restricted, so the economic/optimal use of every drop of water is highly desired. As only a limited studies on the economic use of irrigation water and phosphorus nutrient on garden pea have been carried out earlier under mid hill conditions, the present investigation was undertaken to study their effect on earliness attributes as well as biological and seed yield. Biological yield includes the straw yield and seed yield and the former serves as a valuable fodder for cattle in the hill regions.

Materials and Methods

Field experiments were carried out during the *rabi* season of 2005-06, 2006-07 and 2007-08 at CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The experimental site is situated at 32.6^0 N latitude and 76.3^0 E longitude and an altitude of 1290 m above msl. The soil of 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: 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

* Department of Biology & Environmental Sciences, CSKHPKV, Palampur

tiller and manual labour. The entire recommended dose of N (50kg/ha), K_2O (60kg/ha), FYM (20t/ha) and P-fertilizer as per sub-plot treatments were applied and mixed. The fertilizers used were composite (12:32:16 NPK), urea (46% N) and muriate of potash (60% K_2O). Garden pea seeds (var. Palam Priya) were soaked in Bavistin (0.1%) solution for 24 hours before sowing. Chlorpyriphos @ 2.5ml/litre of water was sprayed within the rows before covering the seeds with soil to protect seed from soil borne insects. 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. Earliness in terms of days to 50% emergence and flowering and days to seed maturity were recorded. Biological and seed yield were recorded plot-wise and converted into q/ha by using the factor 0.01587. Data recorded were statistically analysed as per the procedure outlined by Gomez and Gomez (1984).

Results and Discussion

Earliness with respect to 50% emergence and 50% flowering were significantly affected by irrigation levels during 2005-06 and 2007-08 but the differences were non-significant during 2006-07 whereas, seed maturity was affected significantly by irrigation levels during all the three years (Table 1). Earliness to 50% emergence and 50% flowering were recorded with those irrigation levels (I_1, I_2, I_3 and I_4) where water-seeding (irrigation within rows just before sowing) was done, as compared to recommended irrigation (I_5) during 2005-06 and 2007-08.

Table 1. Effect of irrigation and phosphorus levels on days to 50% emergence, 50% flowering and seed maturity in garden pea during 2005-06, 2006-07 and 2007-08

	Days to 50% emergence			Days to 50% flowering			Days to seed maturity		
	2005-06	2006-07	2007-08	2005-06	2006-07	2007-08	2005-06	2006-07	2007-08
Irrigation									
I_1	21.33	13.22	21.00	84.33	93.44	98.67	136.44	140.44	144.89
I_2	22.33	13.22	19.89	84.67	93.44	99.89	136.89	141.56	147.00
I_3	21.78	13.44	20.44	84.67	93.22	98.67	136.78	142.33	147.33
I_4	21.44	13.22	20.22	83.78	92.44	98.11	137.89	141.67	146.89
I_5	23.78	13.56	25.56	86.11	93.78	101.33	141.44	144.56	151.00
CD (P=0.05)	1.43	NS	1.41	0.98	NS	1.36	1.81	2.08	1.15
Phosphorus									
P_1	22.40	13.27	21.47	85.67	93.67	99.93	138.87	142.40	148.47
P_2	22.13	13.40	21.60	84.67	93.40	99.47	138.07	142.80	147.47
P_3	21.87	13.33	21.20	83.80	92.73	98.60	136.73	141.13	146.33
CD (P=0.05)	NS	NS	NS	0.66	NS	0.90	1.34	0.95	0.84

Reduction of irrigation water at all the critical growth stages (I_4) and also omitting limited irrigation water at one or more of the critical stages (I_2 and I_3), except water-seeding (I_1), led to earlier seed maturity as compared to the recommended irrigation (I_5) during all the three years. This implies that more water quantity in plant system will lead to physiological activity for a longer period. As far as P-levels are concerned, the effect of different P doses proved non-significant for early emergence in all the years whereas, the highest P-dose (P_3) resulted in significantly earlier flowering in comparison to P_2 and P_1 during 2005-06 and 2006-07 but P_2 was at par with P_3 during 2007-08 which may be attributed to improvement in soil-phosphorus due to continuous application of P-fertilizer during three years of experimentation. Similarly early seed maturity was recorded with P_3 during all the three years but it was at par with P_2 during 2005-06 only. The beneficial response of P-fertilizer on early flowering and seed maturity in garden pea is on the account of the fact that P-application plays a pivotal role in energetic metabolism and biosynthetic reactions as a component of ATP, NAD, NADP and RNA which govern cell multiplication resulted in rapid completion of vegetative growth (Kanaujia *et al.*, 1997). The present findings are similar to Sinha *et al.* (2000) who have also observed earlier flowering and seed maturity with higher P-dose while working on garden pea. The irrigation x phosphorus interaction was significant for days to seed maturity during 2006-07 only (Table 2).

All the phosphorus levels were at par at the irrigation levels I_1, I_2 and I_5 whereas the

phosphorus level P_3 took significantly lesser number of days (139.33 and 140.00 days respectively) as compared to P_2 and P_1 levels at the irrigation levels I_4 and I_3. The irrigation levels I_1, I_2, I_3 and I_4 at different phosphorus levels took less number of days as compared to I_5 and were at par with each other except I_3P_1 and I_2P_3 which in turn were at par with I_4P_1 and I_5P_1 and I_1P_3 and I_5P_3, respectively. The treatment combination I_4P_3 took minimum number of days (139.33) to seed maturity which was at par with I_1P_1, I_1P_2, I_1P_3, I_2P_1, I_2P_2 and I_3P_3.

Biological yield (q/ha) and seed yield (q/ha) were significantly affected by different irrigation levels during all the three years (Table 3). The irrigation level I_5 recorded the highest biological as well as seed yield but was at par with I_4 and both these levels were significantly superior over I_1, I_2 and I_3 during all the three years. Dubey *et al.* (1999) in pea and Dhar and Singh (1995) in French bean have also observed beneficial effect of irrigation at critical stages on vine and straw yield, respectively.

Among the P-levels, P_3 was higher in biological as well as seed yield during all the three years and was significantly higher over P_2 and P_1 levels except P_2 in 2006-07 and 2007-08 for biological yield and seed yield, respectively. Similar reports were given by Dass *et al.*, (2005),

Table 2. Interaction effect of irrigation and phosphorus levels on days to seed maturity in garden pea during 2006-07

Treatments	2006-07		
	Phosphorus (P)		
Irrigation (I)	P_1	P_2	P_3
I_1	140.00	141.67	139.67
I_2	140.67	141.67	142.33
I_3	144.33	142.67	140.00
I_4	142.33	143.33	139.33
I_5	144.67	144.67	144.33
CD (P=0.05) to compare different phosphorus (P) levels at same level of irrigation (I)z			2.13
CD (P=0.05) to compare different irrigation (I) levels at same or different levels of phosphorus (P)			2.71

Table 3. Effect of irrigation and phosphorus levels on biological and seed yield in garden pea during 2005-06, 2006-07 and 2007-08

	Biological yield (q/ha)			Seed yield (q/ha)		
	2005-06	2006-07	2007-08	2005-06	2006-07	2007-08
Irrigation						
I_1	35.84	35.05	31.96	11.11	8.70	8.42
I_2	35.80	37.17	34.92	11.06	9.44	8.56
I_3	36.77	40.08	41.05	11.46	10.60	9.44
I_4	43.12	46.65	45.37	13.29	13.65	13.20
I_5	43.39	46.96	45.25	13.74	14.07	13.41
CD (P=0.05)	1.19	0.59	1.67	0.53	0.54	0.57
Phosphorus						
P_1	37.78	39.31	38.01	11.44	10.29	10.05
P_2	38.99	41.77	40.16	12.13	11.42	10.74
P_3	40.18	42.46	40.96	12.83	12.18	11.04
CD (P=0.05)	0.88	0.75	0.62	0.27	0.38	0.37

Bhatt *et al.* (2002) and Masand *et al.* (2006) who have recorded higher straw/seed/pod yields with the application of higher doses of P nutrient. Irrigation x phosphorus interaction was significant for biological as well as seed yield only during 2007-08 and 2006-07 respectively (Table 4). The P-levels P_3 and P_2 were on par at irrigation levels I_5, I_4 and I_1 whereas P_3 gave significantly higher biological yield over P_2 and P_1 at I_2 and I_3 irrigation levels whereas in seed yield, 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. However, irrigation level I_4 was at par with I_5 irrespective of P-levels in biological as well as seed yield.

Table 4. Interaction effect of irrigation and phosphorus levels on biological and seed yield in garden pea during 2007-08 and 2006-07, respectively

Treatment	Biological yield (q/ha) 2007-08			Seed yield (q/ha) 2006-07		
	Phosphorus (P)					
Irrigation (I)	P_1	P_2	P_3	P_1	P_2	P_3
I_1	29.74	33.20	32.94	8.28	8.57	9.26
I_2	32.54	35.32	36.90	8.76	9.74	9.84
I_3	39.29	40.61	43.25	9.92	10.79	11.08
I_4	44.31	46.16	45.64	12.14	13.68	15.13
I_5	44.18	45.50	46.16	12.33	14.31	15.58
CD(P=0.05) to compare different phosphorus (P) levels at same level of irrigation (I)			1.38			0.86
CD(P=0.05) to compare different irrigation (I) levels at same or different levels of phosphorus (P)			2.02			0.88

The study suggested that judicious use of water I_4 (water-seeding + irrigation (1cm) at all the critical growth stages) alongwith P_3 @ 80kg P_2O_5/ha is sufficient to attain early maturity, maximum seed as well as biological yield potential in mid hill conditions of Himachal Pradesh.

References

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.

Dhar S and Singh NP 1995. Effect of irrigation schedules on yield attributes, consumptive use of water, water use efficiency and moisture extraction pattern of French bean (*Phaseolus vulgaris*). Indian J. Agron. **40**: 620-25.

Dubey YP, Kaistha BP and Jaggi RC 1999. Influence of irrigation and phosphorus on growth, green pod yield and nutrient uptake of pea ((*Pisum sativum*) in Lahaul Valley of Himachal Pradesh. Indian J. Agron. **44**: 137-40.

Gomez KA and Gomez AA 1984. *Statistical Procedures for Agricultural Research.* A Wiley-Interscience Publication, John Wiley and Sons, New York, USA.

Kanaujia SP, Rastogi KB and Sharma SK 1997. Effect of phosphorus, potassium and Rhizobium inoculation on growth, yield and quality of pea cv. Lincoln. Veg. Sci. **24**: 91-94.

Masand SS, Kapur OC and Bassi K 2006. Effect of irrigation and phosphorus on pea under limited water supply in Kullu valley of Himachal Pradesh. **In**: Natl. Seminar INM for Balanced Fertilization, CSKHPKV, Palampur, 17-18 November.

Sinha BN, Mehta, BS and Joydip M 2000. Quality and seed yield of garden pea (*Pisum sativum* L.) cultivars as influenced by date of planting and phosphorus levels. Indian J. Agric. Sci. **70**: 248-49.