International Journal of Agriculture Innovations and Research
Volume 3, Issue 2, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 28/09/2014 | Accepted on : 07/10/2014 | Published : 11/10/2014

Effect of Seed Size on Germination and Yield Characters in Fieldpea (*Pisum sativum* L.)

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***Abstract* – An experiment was conducted determine the effect of seed size (small and bold) on germination, pod and seed development in fieldpea (*Pisum sativum* L). Effect of seed size was significant on yield characters, germination percent, root length, shoot length and seedling length. Genotype bold FP 12-115 was identified as a desirable genotype with more number of pods per plant (21.66), high seed yield per plant (12.73 g), more number of seeds per plant (6.33) and maximum pod weight per plant (14.78 g). FP12-109 genotype was identified as a desirable genotype with less number of days to 50% flowering (59 days) and days to maturity (125.33 days), more number of branches per plant (30.33) and high biological yield (50.49 g). Bold FP12-94 genotype was identified as a desirable genotype with maximum plant height (53.83 cm). Genotype bold FP 12-109 showed maximum shoot length (12.33 cm) and seedling length (23.00 cm). Bold FP 12-107 genotype recorded maximum root length (11.66 cm) and genotype bold FP 12-115 genotype showed high germination (97.00 %).**

***Keywords* – Fieldpea (*Pisum sativum* L.), Seed Size, Germination Percentage, Pod, Seed Development.**

I. INTRODUCTION

Fieldpea (*Pisum sativum* L.) is amongst the most important legume crop of India belongs to family leguminosae largely confined to cooler temperate zone between the tropic of cancer and Mediterranean region. Uttar Pradesh ranks first in area (0.4 million hectare) and about 90% of its area and production is limited to Uttar Pradesh alone. (**Agriculture Ministry of India, 2013**). In pulses reproductive allocation is theorized to represent a trade-off in quantity versus quality of offspring and in plants is thought to be characterized in the size versus number of seeds produced by the plant **(Smith and Fretwell, 1974)**. Large seeds have been demonstrated to have a competitive advantage over small seeds by having higher germination rates and having greater nutrient reserves for the young seedlings, which enable the seedlings to grow larger to tap resources earlier than their small-seeded counterparts. Seedlings from large-seeded species should be able to establish under a wider range of environmental conditions that could not be tolerated by seedlings from small-seeded species **(Wulff, 1986).** Larger size is the result of containing extra nutrient reserves for the growth of the resultant seedlings and not by an absolute numerical interval **(Silvertown, 1981).** Quality seed plays an important role in germination and seedling vigour and ultimately grain yield. Small seeds although capable of germination do not seem to be as vigorous as large seed nor do they maintain viability in storage as well. Moreover, the presence of small seeds seems to reduce the apparent value of a seed lot **(Stanton, 1984).** In fieldpea, the overall yield depends upon number of pods and size of seed. It is well known that the size and number of pods are the genetically determined characters **(Atkins *et al.*, 1977)**.

II. MATERIALS AND METHODS

An experiment was conducted to determine the effect of seed size (small and bold) on germination percentage, pod and seed development in fieldpea (*Pisum sativum* L), in *rabi* season 2012-2013 at the Field Experimentation Centre of Department of Genetics and Plant Breeding, S H I A T S, Allahabad in Randomized Block Design with three replications. The experiment comprising of 12 diverse genotypes for small and bold seeded fieldpea with spacing of 30×20. Data was recorded on *viz.,* days to 50% flowering, plant height (cm), number of branches per plot, number of pods per pod, days to maturity, number of seeds per pod, pod length (cm), seed index (g), seed yield per plant (g), biological yield (g), germination (%), root length (cm), shoot length (cm), seedling length (cm) and seed vigour index on three randomly selected plants per replications per genotype. The experimental data was subjected to suitable statistical analysis for the parameters, *viz*., analysis of variance, range, mean, critical difference and coefficient of variation **(Fisher, 1936).**

III. RESULTS AND DISCUSSION

Effect of seed size was significant on days to 50% flowering, plant height (cm), number of branches per plot, number of pods per pod, days to maturity, number of seeds per pod, pod length (cm), seed index (g), seed yield per plant (g), biological yield (g) (Table1 2). Effect of seed size was also significant on germination (%), root length (cm), shoot length (cm), seedling length (cm) (Table 3). However the effect of seed size was non-significant on seed vigour index. Maximum plant height (54.33cm), number of branches per plant (30.33), number of pods per plant (21.66), number of seeds per pod (6.33), pod length (5.33cm), seed yield per plant (12.73g), biological yield (50.49g) germination (97%), root length (11.66cm), shoot length (12.33cm), seedling length (23cm) were achieved by large seeds. **Reuzeau *et al.* (1992)** stated that lipid concentration was high in small seeds with high germinability than in big seeds which were poor germinator.

International Journal of Agriculture Innovations and Research
Volume 3, Issue 2, ISSN (Online) 2319-1473

Table 1: Mean performance of small seeded fieldpea for pre and post-harvest characters

Genotypes		Days to 50% flowering	Plant height (cm)	Number of branches / plant	Days to maturity	Number of pods / plant	Pod length (cm)	Number of seeds per pod	Weight of pods per plant	Seed index (gm)	Biological yield	Seed yield / plant (gm)
FP 12-90		75.00	33.33	20.67	146.00	12.00	4.40	4.33	12.42	30.78	43.63	10.45
FP 12-93		74.00	30.67	16.67	140.67	11.00	4.17	4.00	12.53	28.75	44.97	10.06
FP 12-94		73.33	32.07	17.00	141.00	9.33	4.03	4.00	9.75	27.98	46.50	8.72
FP 12-95		79.67	32.33	13.00	144.00	13.00	4.37	5.67	13.18	30.72	46.13	11.00
FP 12-100		74.67	34.67	17.67	141.33	8.00	3.97	5.00	8.50	25.23	43.13	7.64
FP 12-102		73.00	34.33	24.00	141.00	11.33	3.90	5.00	11.81	31.74	45.93	10.41
FP 12-103		74.33	44.67	15.00	140.33	11.33	4.07	4.67	11.79	30.17	44.93	9.93
FP 12-104		73.00	49.17	18.67	143.67	11.00	3.80	5.00	11.34	26.00	43.57	9.85
FP 12-107		72.67	35.17	18.00	141.67	11.33	4.03	5.33	11.55	31.04	46.60	10.26
FP 12-109		73.33	40.67	18.00	142.00	8.33	4.27	4.33	8.86	29.16	48.20	8.84
FP 12-113		68.33	53.83	19.33	140.00	10.33	3.87	4.00	10.90	30.36	44.30	9.38
FP 12-115		70.00	32.67	19.33	142.00	13.67	4.00	6.00	14.02	35.70	46.40	12.99
Grand Mean		**73.44**	**37.80**	**18.11**	**141.97**	**10.89**	**4.07**	**4.78**	**11.39**	**29.80**	**45.36**	**9.96**
S E		1.60	1.10	1.97	1.29	1.47	0.20	0.45	1.38	1.42	1.88	0.85
CD 5%		3.43	2.34	4.21	2.76	3.13	0.42	0.95	2.95	3.03	4.01	1.82
Range	**Max**	79.67	53.83	24	146	13.67	4.4	6	14.02	35.7	48.2	12.99
	Min	68.33	30.67	13	140	8	3.8	4	8.5	25.23	43.13	7.64

Table 2: Mean performance of bold seeded fieldpea for pre and post-harvest characters

Genotypes		Days to 50% flowering	Plant height (cm)	Number of branches/ plant	Days to maturity	Number of pods/ plant	Pod length (cm)	Number of seeds / pod	Weight of pods / plant	Seed index (gm)	Biological yield	Seed yield / plant (gm)
FP 12-90		60.66	47.83	24.66	132.33	17.66	5.13	4.66	13.95	31.75	48.65	12.39
FP 12-93		61.33	46.00	20.66	131.66	16.66	5.16	5.00	14.02	30.87	45.69	11.46
FP 12-94		63.67	54.33	20.33	128.33	16.33	5.16	4.33	13.74	31.84	48.09	10.13
FP 12-95		62.33	48.67	17.33	127.66	19.00	3.66	6.00	13.88	31.93	48.61	11.04
FP 12-100		61.67	54.00	20.66	130.66	15.66	4.83	5.66	9.14	28.97	49.46	9.21
FP 12-102		63.00	52.83	20.33	133.00	18.00	5.33	5.66	12.37	32.17	46.50	9.87
FP 12-103		62.00	53.67	18.00	128.66	15.33	5.20	5.00	12.60	31.02	46.52	11.86
FP 12-104		60.67	53.67	19.33	130.00	16.66	5.16	5.33	12.61	27.60	45.23	10.57
FP 12-107		65.33	45.67	18.33	133.33	20.00	5.20	4.66	12.99	32.32	47.08	10.60
FP 12-109		59.00	48.00	30.33	135.33	17.33	4.63	5.00	10.60	31.17	50.49	11.05
FP 12-113		60.67	51.33	22.00	132.33	16.33	4.96	5.00	12.58	32.51	45.65	10.88
FP 12-115		59.33	51.33	26.33	125.33	21.66	5.10	6.33	14.78	37.03	49.75	12.73
Grand Mean		**61.63**	**50.61**	**21.52**	**130.72**	**17.55**	**4.96**	**5.22**	**12.77**	**31.60**	**47.64**	**10.98**
S E		**1.08**	**1.47**	**4.20**	**1.81**	**1.42**	**0.22**	**0.46**	**1.42**	**1.42**	**2.09**	**0.70**
CD 5%		**2.30**	**3.13**	**8.95**	**3.86**	**3.03**	**0.48**	**0.98**	**3.04**	**3.04**	**4.46**	**1.50**
Range	**Max**	65.33	54.33	30.33	135.33	21.66	5.33	6.33	14.78	37.03	50.49	12.73
	Min	59	45.66	17.33	125.33	15.33	3.66	4.33	9.14	27.6	45.23	9.21

Table 3: Mean performance of fieldpea genotypes for lab characters

Genotypes		Small seeded field pea					Bold seeded field pea				
		Germination percentage	Root length (cm.)	Shoot length (cm.)	Seedling length (cm.)	seedling vigour index (g)	Germination percentage	Root length (cm.)	Shoot length (cm.)	Seedling length (cm.)	seedling vigour index (gm)
FP 12-90		89.00	10.00	9.00	19.00	1,690.33	92.33	11.66	10.33	22.00	2028.33
FP 12-93		90.00	9.00	5.00	14.00	1,255.33	91.66	10.66	8.66	19.33	1773.66
FP 12-94		88.66	9.00	7.00	16.00	1,433.66	92.33	9.33	8.00	17.33	1718.66
FP 12-95		87.00	10.00	7.66	17.66	1,554.00	94.00	10.33	9.00	19.33	1824.00
FP 12-100		89.00	10.00	11.66	21.66	1,875.33	92.00	10.00	11.66	21.66	1900.00
FP 12-102		89.00	12.00	7.00	19.00	1,788.00	91.66	11.33	11.66	23.00	1954.00
FP 12-103		88.00	11.00	8.66	19.66	1,839.33	93.00	10.00	10.66	20.66	2016.33
FP 12-104		88.00	7.00	7.33	14.33	1,148.33	93.66	11.00	9.00	20.00	1867.33
FP 12-107		91.00	8.00	7.33	15.33	1,516.66	93.33	11.66	10.33	22.00	2144.00
FP 12-109		91.00	11.00	5.00	16.00	1,461.33	93.66	8.66	12.33	21.00	2030.33
FP 12-113		92.00	10.00	6.00	16.00	1,539.33	95.00	10.33	10.66	21.00	2032.66
FP 12-115		93.00	12.00	11.00	23.00	2,271.33	97.00	11.00	12.00	23.00	2231.00
Grand mean		**89.63**	**9.91**	**7.72**	**17.63**	**1,614.42**	**93.30**	**10.5**	**10.36**	**20.86**	**1960.02**
SE		0.78	0.83	0.73	1.12	70.68	2.52	1.14	0.99	1.45	**156.60**
CD5%		2.31	2.44	2.17	3.30	207.55	5.38	2.44	2.11	3.10	**333.72**
Range	**Max**	93	12	11.66	23	2,271.33	97	11.66	12.33	23	2231
	Min	87	7	5	14	1,148.33	91.66	8.66	8	17.33	1718.66

Other studies have pointed out a positive relationship between seed size and germination success **(Khan, 2004)**, while seedling vigor is especially important in determining the success of seedlings under competitive conditions **(Eriksson, 1999)**. Therefore, seed size may be an important factor determining which individuals succeed in the high density patches of seedlings **(Pizo *et al*. 2001).** Seedlings emerging from larger seeds may enjoy a lot of food supply from the larger cotyledons of their seeds than those from small seeds **(Agboola, 1996)**. However, as soon as seedlings from both seed sizes start to photosynthesise, the favourable effect of large size seeds with larger cotyledons would have been diminished **(Ebofin *et al*., 2003).** Under normal condition and in moderate stress condition, higher germination percentage in large seeds may have little advantage compared to other seed sizes due to little differences in germination percentage. Under extreme stress conditions, larger seeds in *Triticale* may have higher benefits in germination compared to smaller seeds. Therefore, higher germination percent from larger seeds may be beneficial in establishing plants under dry soil conditions **(Mian *et al*. 1994). Willenborg *et al.* (2005)** reported that large oat seeds had greater final germination that resulted in better stand establishment, particularly where low spring soil moisture limits plant establishment than that of small seeds. Therefore, larger seeds had an advantage of seedling establishment in low soil moisture condition due to larger root system **(Leishman *et al*. 2000).** Roots play an important role in plant survival during periods of drought and also drought resistance is characterized by an extensive root growth and small reduction of shoot growth in drought stressed conditions. Moreover, **Westoby *et al*. (1996)** reported that seedlings of larger-seeded species were better able to survive drought. **Camacho and Caraballo, (1994)** reported that root dry weight was identified as the major criterion for selection of maize genotypes under drought conditions. Therefore, large seeds may alleviate the negative effects of drought stress on seedling. **Al-Karaki, (1998)** reported that lentil seedlings from large seeds had higher shoot dry matter than those from small seeds. Moreover, large kernel weight was considered as a possible characteristic that may improve the drought resistance of short-duration pigeonpea.

IV. Conclusion

The results from the present investigation can be concluded that bold FP 12-115 genotype was identified as a desirable genotype with more number of pods per plant, high seed yield per plant, more number of seeds per plant, high seed index and maximum weight of pods per plant. FP12-109 genotype was identified as a desirable genotype with less number of days to 50% flowering and days to maturity, more number of branches per plant and high biological yield. Bold FP12-94 genotype was identified as a desirable genotype with maximum plant height. Genotype bold FP 12-109 showed maximum shoot length and seedling length. Bold FP 12-107 genotype recorded maximum root length and genotype bold FP 12-115 genotype showed high germination percentage. Thus the small seeds reduce the germination, growth and yield of plant. However, the stimulation of germination, growth and yield were observed by bold seeds. So it is suggested that bold seeds should be chosen before sowing for high germination and better yield.

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