Evaluation of pea genotypes under optimum sowing condition in Bangladesh

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Abstract

The study was conducted with ten genotypes and evaluated as germplasm 2013-14 at Natore district and were sown further in three different environments (relay so wing at optimum time as a relay crop, sole sowing at optimum time as a relay crop and sole sowing at optimum time as a sole crop) at Pulses Research Centre, Ishurdi, Pabna, Bangladesh during Rabi 2014-15 to identify suitable genotypes for relay cropping as well as for sole cropping. Ten genotypes are Natore local-1, Jhikorgacha local, IPSA-3, Bagha local, BARI Garden pea-1, BD-4190, BD-4142, BD-4181, BARI Garden pea-3 and Natore Local-2.The experiment was done in a RCB split-plot design with three replications. Each entry was sown in a plot of 8 rows x 4 m length plot with line to line spacing of 35 cm and plant to plant 7 cm. Post sowing irrigation was given to ensure seed germination in sole condition while relay sowing was done under optimum soil moisture condition. There were significant difference in pod yield and fodder yields, days to first pod harvest and days to maturity in three type of sowing. In general 12 November sole sowing produced significantly higher pod yield and fodder yield but it was statistically non-significant for seed yield. However there was significant interaction of type of sowing with genotypes. BARI Garden pea-1 produced significantly higher pod yield in both sole sowing (10.7 t/ha in 01 Nov. & 17.0 t/ha in 12 November) followed by IPSA-3 while in relay sowing the highest yield was recorded in IPSA-3 (6.5 t/h). But in 2013-14, IPSA-3 was severely damaged by foot rot while BARI Garden pea-3 completely failed to germinate in relay sowing under excess moist condition but Natore local-2 performed good even in that situation. For fodder yields Natore local-2 produced the highest mean yield (12.2 t/ha) and Natore local-1 (11.2 t/ha) followed by Bagha local (10.11 ton/ha) and BARI Garden pea-1(10.33 ton/ha). In case of seed yield again IPSA-3 gave the highest seed yield of 2.65 t/ha and BARI Garden pea-1 (2.34 t/ha) followed by Natore local-2(2.14 ton/ha) and Jhikorgacha local (2.11 ton/ha).

Key words: Pea, *Pisum sativum*, Genotypes, Evaluation, different environment

Introduction

Pea (*Pisum sativum* L.) is the fourth leading legume in terms of consumption in the world. It is rich in protein, used in rotation with cereals and oil seeds. Pea is an important winter pulse crop of west Europe, North America, India, Australia, Pakistan and South America. In Bangladesh it cultivated dispersedly under a wide range of different region, this is an important winter Pulse crop of India and was among the first crop cultivated by human being. This crop is highly productive, grown for food and forage. Field pea is extensively used as green pod, dry, whole or split pulse (dal). This crop plays an important role in nourishment because of a rich source of proteins, carbohydrates and vitamins for human nutrition. Relay cropping pea with different pea species is a very promising practice due to many benefits that can be derived from this system. In relay pea straw height can help maintain soil fertility by fixing nitrogen from the atmosphere, to increase soil organic matter through the biomass inputs of roots and aerial parts, and to mitigate nutrient loss (Babbar & Zak, 1995). Straw height also provides a microclimate which attenuates air and soil extreme temperature, preserves surface soil humidity and protects pea from the impact caused by rain, hail and winds. In the country this crop is grown in about 0.76 million hectare

with annual production of 0.7 million tones. Field pea has high levels of essential amino acids, lysine and tryptophan, which are usually low in cereal grains. The major production constraints in field pea have been found such as lack of improved high yielding varieties, on-availability of irrigation and use of poor quality seeds. The Genetic Resource and Seed Unit (GRSU) of the AVRDC aim to set up a core-collection (Holden and Williams, 1984) or a condensed, yet representative, assembly of accessions from this germplasm collection. To improve the genetic contents of any crops, genetic variability is a prerequisite for crop improvement program. This collection has been acquired mainly through personal contact and exchange through different institution and individuals (Tey et al, 1989). The loss of genetic diversity has been dramatic for many cultivated species (Wikes, 1983).

Evaluation of field pea genotypes for yield and quality attributing traits are one of the important activities of the breeders deputed in field pea improvement program. Development of cultivars with early maturity, acceptable green pod, grain quality, resistance to some important diseases and pests has significantly increased the yield and cultivated area (Ehlers and Hall, 1997). To select the better genotypes for the improvement of the genetic constitutions of the field pea is required now to fulfill the future increasing demand. Grain yield, grain quality and resistance are three important objectives of field pea breeding program in developing countries. Agricultural scientists are trying their best to increase the agricultural productivity in the country. Three possible strategies to achieve the goal include: expansion of agricultural land, increasing the cropped area and per unit area productivity. Land as a whole is a limited resource and in a country like Bangladesh where there is a high rate of urbanization. It is very difficult to increase the agricultural land. Similarly the increase in cropped area is not an easy task because of the economic condition of the farmers. Under such conditions, increase in per unit area productivity is the only option which demands many things such as improved cultivars, high inputs, efficient cultural practices etc. Our farmers cannot afford high inputs in terms of more fertilizer and/or pesticide application. Therefore, the only alternative is to evolve high yielding cultivars and their adaptability to local conditions to increase yield per unit area. Ashraf et al.(1981) analyzed partial correlation in eight pea cultivars and found that days to first picking and pod and seed weight per plant were positively and significantly correlated. Gent (1976) made three years trial on 11 pea cultivars and found that cv. Ceb-201 was high yielding. Cervato et al. (1984) tested nine commercials cultivars and new lines for early maturity, yield and flexibility in harvesting dates. But it has enough opportunity in rice based cropping system where the farmers remain their land fallow about 80- 90 days between Aman and Boro rice. If the farmers get pea variety they will be able to grow pea in between rice either as sole or relay cropping. To achieve such goals the present investigation evaluation of pea genotypes under different condition has been conducted with the following objectives, In some areas of Bangladesh (like Natore) field peas are grown as relay crop with T. Aman rice and farmers sell green pods as vegetable and the plants are used as fodder and following Boro rice. Boro rice has replaced pulses areas including peas in most places, peas can be inserted in between Aman and Boro/T.Aus rice as vegetable (cash crop) a large area may come under pea without disturbing the Aman-Boro/T.Aus cropping pattern and to evaluate the existing cultivars/varieties of pea under relay cropping condition with Aman rice to select appropriate variety in the above cropping pattern.

Materials and Methods

Ten genotypes evaluated as germplasm evaluation trial in 2013-14 at farmers fields in Natore district were sown further in three different environments (relay sowing at optimum time as a relay crop, sole sowing at optimum time as a relay crop and sole sowing at optimum time as a sole crop) at Pulses Research Centre, Ishurdi, Pabna, Bangladesh during Rabi 2014-15 to identify suitable genotypes for relay cropping as well as for sole cropping. Ten genotypes are Natore Local-1, Jhikorgacha Local, IPSA-3, Bagha local, BARI Garden pea-1, BD-4190, BD-4142, BD-4181, BARI Garden pea-3 and Natore Local-2. The genotypes were sown on 01 November for relay as well as sole cropping and again as sole cropping at the optimum time (12th November)

after proper land preparation. The experiment was done in a RCB split-plot design with three replications. Each entry was sown in a plot of 8 rows x 4 m length plot with line to line spacing of 35 cm and plant to plant 7 cm. Post sowing irrigation was given to ensure seed germination in sole condition while relay sowing was done under optimum soil moisture condition. Recommended fertilizers were used at the rate of 40, 100, 40 and 50 kg Urea, TSP, MOP and gypsum, respectively. Necessary intercultural operations were done as and when necessary. Selection emphasis was given on short duration and disease reaction (Powdery mildew and Rust) to fit them in between Aman and Boro rice. Some were also selected for their high yield and disease reaction so that they can be grown as relay crop or sole crop. The screening of rust and powdery mildew diseases were done just in natural environment. At maturity best individual lines were selected on the basis of earliness, disease reaction, insect susceptibility (against pod borer) and higher yield. The traits were included days to maturity, plant height, branches/plant, pods/plant, populations/m^2, fodder yield (ton/ha), pod yield (ton/ha) in different dates, seed yield (ton/ha) and 100 SW (gm). The yield data was taken from 2 m^2 area in a plot while the yield contributing traits were recorded from five randomly selected plants. Percent of foot rot was counted from 2 m^2 area and powdery mildew disease score (0-5 scale) was recorded from the whole plot. The statistical analysis was done using Genstate 5 computer software.

Result and Discussion

The effect of different dates in three different environments (01 November relay, 01 November sole and again 12 November sole) on yield and yield contributing characters are presented in Table 1, Table 2 and Table 3. There were significant difference in pod yield and fodder yields, days to first pod harvest and days to maturity in three type of sowing. There is a significantly difference in three different environments in different dates. The genotypes Notore local-2, Garden pea -1 and IPSA-3 has shown significantly difference for all environment. In general 12 November sole sowing produced significantly higher pod yield and fodder yield but it was statistically non significant for seed yield. There is no noticeable competition for water, light and air competition is the most limiting factor and should be focused on future studies. The similar result was observed in 2013-14 (Table-1). However there was significant interaction of type of sowing with genotypes. BARI Garden pea-1 produced significantly higher pod yield in both sole sowing (10.7 t/h in 01 November & 17.0 t/h in 12 November.) followed by IPSA-3 while in relay sowing the highest yield was recorded in IPSA-3 (6.59 t/h). Hence IPSA-3 may be selected for both sole and relay sowing. But in 2013-14, IPSA-3 was severely damaged by foot rot while BARI Garden pea-3 completely failed to germinate in relay sowing under excess moist condition but Natore local-2 performed good even in that situation (Table 1). There is a significant difference among the genotypes for fodder yields Natore local-2 produced the highest mean yield (12.2 t/ha) and Natore local-1 (11.2 t/ha) Followed by Bagha local (10.11 ton/ha) and BARI Garden pea-1(10.33 ton/ha) in Table 2. Results show significant difference among the genotypes (Table 2) for seed yield. In case of seed yield again IPSA-3 gave the highest seed yield of 2.65 t/ha and BARI Garden pea-1 (2.34 t/ha) followed by Natore local-2(2.14 ton/ha) and Jhikorgacha local (2.11 ton/ha).The yield data was taken from 2 m^2 area in a plot while the yield contributing traits were recorded from five randomly selected plants. Percent of foot rot was counted from 2 m^2 area and powdery mildew disease score (0-5 scale) was recorded from the whole plot.

In regards of other traits, relay sowing took 5-7 days less in first pod harvesting and maturity. However there was no significant difference regarding plant height, braches/plant and 100 seed weight in three type of sowing. Bagha local produced the highest number of pods per plant (6) while the highest hundred seed weight (23.1g) was recorded in BARI Garden pea-3. The genotypes BARI Garden pea-3 and IPSA-3 were found resistant to powdery mildew in all type of sowing (Table 3).

Table 1. Performances of green pod yield of 10 pea genotypes in three different environments in 2013-14 and 2014-15 cropping season

Genotypes	Pod yield (t/ha) in different Dates									
	2014-15				2013-14					
	SS	SSR	RSR	Mean	SS	SSR	RSR	Mean	3*	% Foot rot
Natore local-1	6.37	6.69	3.95	5.67	4.66	6.30	3.80	4.92	43	0
Jhikorgacha local	7.30	7.68	4.14	6.37	5.9	5.92	4.35	5.39	48	0
IPSA-3	7.52	12.41	6.59	8.84	3.72	8.4	5.95	6.02	38	43
Bagha local	4.48	4.98	2.83	4.09	4.56	3.9	3.00	3.82	26	0
BARI Garden pea-1	10.79	17.00	5.77	11.19	5.84	9.31	5.35	6.83	36	2
BD-4190	4.03	3.88	3.08	3.66	4.67	4.74	3.55	4.32	24	0
BD-4142	4.62	4.33	3.79	4.24	3.98	3.79	4.00	3.92	49	0
BD-4181	4.15	3.39	2.77	3.44	1.11	2.91	3.01	2.34	24	5
BARI Garden pea-3	4.24	8.21	3.26	5.24	2.75	6.27	3.50	4.17	0	-
Natore local-2	5.61	5.43	4.65	5.23	5.36	7.37	4.77	5.83	65	0
SE	517			-	455					-
Level of sig.	**			-	**					-
CV (%)	13.2			-	--					-

NB, SS= Sole sowing at 01 November, SSR = Sole sowing at 12 November, RSR = relay sowing at 01 November and 3* = Population/11.2 m² plot in relay sowing

Table 2. Performances of green pod yield, fodder yield and seed yield of 10 pea genotypes in three different environments 2014-15

Genotypes	Dates							
	SS	SSR	RSR	Mean	SS	SSR	RSR	Mean
	Fodder yield (ton/ha)				Seed yield (ton/ha)			
Natore local-1	12.11	13.92	7.79	11.27	2.11	2.19	1.96	2.09
Jhikorgacha local	8.57	12.65	6.95	9.39	2.13	2.24	1.97	2.11
IPSA-3	5.87	10.43	5.60	7.30	2.63	2.85	2.46	2.65
Bagha local	10.95	11.56	7.83	10.11	1.95	1.95	1.85	1.92
BARIGarden pea-1	9.77	14.56	6.67	10.33	2.16	2.71	2.14	2.34
BD-4190	10.44	10.33	6.83	9.20	1.71	1.78	1.63	1.71
BD-4142	9.30	12.36	7.20	9.63	1.47	1.59	1.42	1.49
BD-4181	10.89	9.35	8.05	9.43	1.38	1.28	1.25	1.31
BARIGarden pea-3	1.27	3.47	1.08	1.94	1.11	1.25	1.06	1.14
Natore local-2	11.86	17.19	7.65	12.23	2.12	2.18	2.10	2.14
SE	1047			-	77			-
Level of sig.	**			-	ns			-
CV (%)	18			-	5.9			-

NB, SS= Sole sowing at 01 November, SSR = Sole sowing at 12 November, RSR = relay sowing at 01 November and 3* = Population/11.2 m² plot in relay sowing.

Table 3. Performance of yield contributing characters of 10 pea genotypes in three different environments

Genotypes	Dates											
	SS	SSR	RSR	Mean	SS	SSR	RSR	Mean	SS	SSR	RSR	Mean
	Days to 1st pod harvest				Days to maturity				Plant height (cm)			
Natore local-1	87	90	84	87	105	104	102	104	155	159	109	141
Jhikorgacha local	87	88	83	86	104	103	100	102	154	155	130	146
IPSA-3	88	86	81	85	101	101	97	100	90	102	77	90
Bagha local	99	95	90	95	113	112	110	112	130	131	110	124
BARIGarden pea-1	92	92	91	92	112	112	107	110	76	79	68	74
BD-4190	103	100	98	100	117	117	111	115	134	145	109	129
BD-4142	97	83	90	90	114	114	107	112	122	126	111	120
BD-4181	104	101	100	102	118	118	112	116	128	126	112	122
BARI Garden pea-3	53	55	48	52	71	70	69	70	32	43	29	35
Natore local-2	91	93	86	90	106	106	101	104	149	158	132	146
SE		0.67		-		0.25		-		10.63		-
Level of sig.		**		-		**		-		ns		-
CV (%)		2.3				0.5		-		12.6		-

NB. SS= Sole sowing at 01 November, SSR = Sole sowing at 12 November and RSR = relay sowing at 01 November

Table 3. Cont.

Genotypes	Dates												
	SS	SSR	RSR	Mean	Mean Branch /pant	Mean 100 SW (g)	SS	SSR	RSR	SS	SSR	RSR	Mean
	Pods/plant						PM (0-5 scale)			Population/m2			
Natore local-1	27	28	20	25	4	10.4	2	4	2	37	37	32	35
Jhikorgacha local	30	31	26	29	3	10.3	2	3	2	37	37	47	40
IPSHA-3	12	15	10	12	3	21.1	1	1	1	39	40	42	40
Bagha local	39	39	32	37	6	5.0	2	3	2	34	36	31	34
BARI Garden pea-1	11	13	10	11	2	14.2	2	5	2	35	36	30	33
BD-4190	33	35	26	31	4	4.9	1	2	1	31	34	31	32
BD-4142	28	32	23	28	5	5.4	2	3	2	31	32	29	31
BD-4181	27	25	13	22	4	5.0	2	4	2	30	30	22	27
BARI Garden pea-3	5	6	5	5	1	23.1	1	1	1	32	36	32	33
Natore local-2	14	15	10	13	3	10.3	2	3	3	35	36	32	34
SE		4.37		-	-	-	-	-	-	-	-	-	-
Level of sig.		ns		-	-	-	-	-	-	-	-	-	-
CV (%)		35		-	31	6						-	-

NB, SS= Sole sowing at 01 November, SSR= Sole sowing at 12 November and RSR = relay sowing at 01 November, PM= Powdery mildew

Conclusion

From this evaluation, optimum sole sowing in 12th November is best for extracting higher yield irrespective of genotypes while IPSA-3 can be selected for any type of sowing under favorable condition. But based on pod shape, size and consumer preference as well as stress tolerance, Natore local-2 may be selected for relay sowing. BARI Garden pea-3 is not suitable for relay cropping, it may be recommended for growing as a sole crop between Aman and Boro rice and early pod harvesting. There is no noticeable competition for water, light and air competition is the most limiting factor and should be focused on future studies.

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