Bangladesh Agron. J. 2014, 17(2): 21-28

YIELD POTENTIAL OF GARDEN PEA VARIETIES AT VARIED HARVESTING DATES

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Key words: Garden pea, harvesting time, variety

Abstract

A field experiment was carried out at the experimental field of Department of Genetics and Plant Breeding of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur during November 2008 through April 2009 to find out the performance of different pea varieties at different harvesting time. The treatments consisted of two factors, which were four harvesting times (70, 80, 90 and 100 days after sowing) and six varieties of garden pea (IPSA Motor shuti-1, IPSA Motor shuti-2, IPSA Motor shuti-3, BARI Motor shuti-1, BARI Motor shuti-3 and Local white). The experiment was laid out in a randomized complete block design with three replications. The maximum pod yield (11.42 t ha^{-1}) was obtained from BARI Motor shuti-1 harvesting at 80 days after sowing which was statistically similar to IPSA Motor shuti-2 harvesting at 80 days after sowing and Local white at same harvesting date and superior to the rest of the treatment combination. The lowest pod yield (5.25 t ha^{-1}) was produced by BARI Motor shuti-1 harvesting at 70 days after sowing.

Introduction

Pea *(Pisum sativum ssp. Hortense)* is well known as a vegetable and one of the important legumes in Bangladesh. It is an annual herbaceous plant of family *Leguminosae* having genus *Pisum* and mostly grown for green pods and seeds. The genus includes 6-7 species. The Mediterranean region, western and central Asia and Ethiopia have been indicated as centers of its origin. For gardening purposes, peas may be classified as garden peas (English peas), snap peas and snow peas (sugar peas). Garden pea varieties have smooth or wrinkled seeds. The green pods and immature seeds are rich in vitamin and have a balanced amino acid composition. Moreover, some important minerals such as calcium, phosphorus and iron are present in abundant quantities in peas which are lacking in cereals. The crop becomes popular for its high nutritive value and good taste. It contains 15-35% protein, 20-25% starch, 4-10% sugar, 0.6-1.5% fat and 2-4% minerals (Makasheva, 1983). The importance of pea as a vegetable crop has sharply increased in many countries of the world. It ranks third or fourth in the worldwide production among the grain legumes (Farrington, 1974). The major green pea producing countries of the world are India, China, USA, France, UK, Egypt, Hungary, Italy, Pakistan, Japan and Thailand. In Bangladesh at present pea is grown in a very small area of 12,477 ha and annual production is about 9,410 metric tons (BBS, 2005). The average dry seed yield is only 0.75 t ha^{-1} which is much lower as compared to other pea growing countries such as USA 3.94 t ha^{-1} (Anon., 1990) and France 3.23 t ha^{-1} (Makasheva, 1983). The low yield is mainly due to the use of low yielding cultivars and lack of good quality seeds and cultural practices. Harvesting time determines the nutrient contents and shelf life in seeds of pea. Harvesting time is

known to affect seed growth and development as it prevails under different conditions in the process of seed development. In Bangladesh vegetable pea is grown during cool period in the winter season having very short durability. Thus time of harvesting is a very important factor which influences yield greatly. Harvesting of peas beyond or before its optimum period causes reduction in quality seed yield. Now a day the average production of field pea in Bangladesh has been drastically reduced due to introduction of HYV Rice and wheat. Thus the scope of its production as field crop has already been limited. On the other hand there is a shortage of off-season vegetable in our country. Green pea can be considered as vegetable crop as it need smaller areas of land and can also be grown without competition with cereal crops. Under frozen condition the vegetable can be used throughout the year. However, it is necessary to determine the appropriate harvesting time to ensure seed quality and maximum productivity. Hence the present study was undertaken to evaluate the performance of different pea varieties harvested at different times.

Materials and Methods

A field experiment was carried out at the experiment field of Department of Genetics and Plant Breeding of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur during November 2008 to April 2009. The experiment was laid out in a Randomized Complete Block Design (RCBD) having two factors with three replications. The unit plot size was 4m x 1m maintaining line to line 30 cm and plant to plant 10 cm. The experimental blocks were separated by 0.6 m. The plots were raised by 10 cm for proper irrigation. The treatments include Factor A: Harvesting time; H_1=30th January' 09 (70 Days After Sowing), H_2= 9th February'09 (80 DAS), H_3=19th February'09 (90 DAS), H_4=1st March'09 (100 DAS) and Factor B: Variety; V_1= IPSA Motor shuti-1, V_2= IPSA Motor shuti-2, V_3= IPSA Motor shuti-3, V_4= BARI Motor shuti-1, V_5= BARI Motor shuti-3, V_6= Local white, The experimental soil was well prepared by deep ploughing with tractor followed harrowing and laddering up to a good tilth. The experimental plots were uniformly fertilized with cow-dung (@ of 10 t ha^{-1}), Urea (@ of 120 kg ha^{-1}), TSP (@ of 160 kg ha^{-1}) and MoP (@ of 100 kg ha^{-1}). The total cow-dung, TSP, MoP and 1/2 urea were applied during the final land preparation and the rest of the urea were top dressed in the plot in two installments. The first installment was top dressed at 21 and the second was at 42 days after sowing. Seeds were sown @ 2-3 seeds hill^{-1} on November 20 in furrows maintaining the row spacing of 30 cm and plant to plant spacing 10 cm. Thinning was done after 7 and 15 days of emergence for keeping desired plant density. Three weeding were done after 15, 30 and 45 days of emergence by hand to avoid competition between the plants and weeds. Proper irrigation was done as and when. Ten plants were randomly selected from each plot for data collection on yield characteristics and pods were collected from the specific plot at the specific harvesting time according to the treatment. For seed production whole plants were harvested from each plot according to the treatment. After harvesting the pod, the seeds were removed and separated by hand.

Results and Discussion

Interaction effects on yield and yield contributing characters of garden pea

Days to 50% flowering

The interaction of variety and harvesting time significantly influenced the days of 50% flowering of the crop (Table 1). The treatments H_1V_1, H_1V_5, H_2V_1, H_2V_5, H_3V_1, H_4V_1 and H_4V_5 showed

50% flowering at 35 days which was the minimum and it was statistically identical to all the treatments except H_1V_4, H_1V_6, H_2V_4, H_2V_6, H_3V_4, H_3V_6, H_4V_4 and H_4V_6. V_6 variety took the longest period (68 days) with the combination of all the harvesting time. Verbitskii (1968) reported that the duration of the period from germination to flowering of the some varieties varied from 20 to 70 days in different years.

Number of branches plant^{-1}

Remarkable variation was found in the number of branches plant^{-1} among the treatments combination of harvesting time and varieties (Table 1). Maximum number of branches (1.80 plant^{-1}) was recorded in H_2V_3 which was significantly higher than other combinations. The lowest number of branches (1.10 plant^{-1}) was obtained from the treatment H_1V_1 which was statistically similar to treatments H_1V_2 and H_1V_4.

Plant height (cm)

Plant height of different varieties of pea was significantly interacted with harvesting time (Table 1). The variety V_3 was the tallest (86.50 cm plant^{-1}) at harvesting time H_3 which was statistically similar to H_4V_3. The shortest plant (17.00 cm plant^{-1}) was found in H_4V_1 and it was statistically similar to H_1V_1, H_2V_1 and H_3V_1.

Table 1. Interaction effect of variety and harvesting time on days to 50% flowering, number of branches per plant and plant height of pea

Treatments		Days to 50% flowering	Number of branches plant^{-1}	Plant height (cm)
H_1	V_1	35.00c	1.10g	20.11j
	V_2	40.00c	1.11g	37.93hi
	V_3	50.00bc	1.55b	61.87c
	V_4	66.00a	1.15fg	46.82e-g
	V_5	35.00c	1.30c-e	44.80f-h
	V_6	68.00a	1.35cd	51.23d-f
H_2	V_1	35.00c	1.27de	20.43j
	V_2	40.00c	1.38cd	38.98g-i
	V_3	50.00bc	1.80a	77.72b
	V_4	66.00a	1.28c-e	53.45c-e
	V_5	35.00c	1.40c	44.39f-i
	V_6	68.00a	1.39cd	59.40cd
H_3	V_1	35.00c	1.22ef	18.00j
	V_2	40.00c	1.30c-e	37.55hi
	V_3	49.33bc	1.35cd	86.50a
	V_4	60.00ab	1.28c-e	55.67cd
	V_5	35.33c	1.36cd	38.48g-i
	V_6	68.00a	1.38cd	59.28cd
H_4	V_1	35.00c	1.37cd	17.00j
	V_2	40.00c	1.28c-e	35.67i
	V_3	50.00bc	1.40c	84.60ab
	V_4	66.00a	1.27de	53.83c-e
	V_5	35.00c	1.34c-e	37.35hi
	V_6	68.00a	1.34c-e	55.93cd
F value		0.07**	6.92**	4.41**
CV (%)		16.06	4.76	9.80

H_1=30th January'09 (70 Days After Sowing), H_2= 9th February'09 (80 DAS), H_3=19th February'09 (90 DAS), H_4=1st March'09 (100 DAS), V_1=IPSA Motor shuti-1, V_2=IPSA Motor shuti-2, V_3=IPSA Motor shuti-3, V_4=BARI Motor shuti-1, V_5=BARI Motor shuti-3, V_6=Local white.

Means in a column followed by same letter(s) are not significantly different at 1 % level of significance.

Pod length (mm pod^{-1})

Pod length of pea varieties varied significantly with different harvesting times (Table 2). The longest pod (63.68 mm pod^{-1}) was observed in the treatment, H_3V_6, which was statistically identical to all the treatments except H_1V_1, H_1V_6, H_3V_1, H_4V_1 and H_4V_3. The lowest pod length (41.57 mm pod^{-1}) was observed with the treatment, H_1V_1.

Pod breadth (mm pod^{-1})

The interaction effect of variety and harvesting time on pod breadth was significant (Table 2). The treatment, H_4V_2 produced the widest pod (13.06 mm pod^{-1}) which was statistically similar to all the treatments except H_1V_4, H_1V_6, H_2V_3, H_2V_4, H_2V_6, H_3V_3, H_3V_4, H_3V_6, H_4V_3, H_4V_4 and H_4V_6. The narrowest pod (9.03 mm pod^{-1}) was obtained by treatment H_4V_3 which was statistically similar to treatments H_1V_6, H_2V_3, H_2V_6 and H_3V_3.

Pod weight (g pod^{-1})

The pod weight g pod^{-1} varied greatly for different varieties of pea at different harvesting levels (Table 2). The maximum pod weight (4.13 g pod^{-1}) was produced by the treatment, H_2V_5 which was statistically superior to the treatments H_1V_1, H_1V_2, H_1V_3, H_1V_4, H_1V_5, H_1V_6, H_2V_2, H_4V_1, H_4V_2, H_4V_3 and H_4V_4. This might be due to combination H_2V_5 received comparatively optimum time for properly growing and did not dried out very much. Environmental factors that suited the genetic potential to be exploited for pod weight. The weather prevailed during this time was perhaps favorable for the maximum vegetative growth of plant and lead to production of higher photosynthetic products which result in maximum pod weight. The lowest pod weight (2.74 g pod^{-1}) was obtained by H_4V_3 of the crop. These findings are supported by Sachan *et al.* (2003).

Number of pods plant^{-1}

Number of pods plant^{-1} is also an important factor among the yield contributing characters. A significant interaction effect for number of pods per plant was observed (Table 2). The highest number of pods (5.47 plant^{-1}) was produced by the treatment, H_2V_4 which was statistically similar to H_1V_3, H_2V_1, H_2V_2, H_2V_3, H_2V_6, H_3V_2, H_3V_3 and H_4V_2 of pea. The minimum number of pods (3.24 pod plant^{-1}) showed by treatment H_1V_4.

Number of seeds pod^{-1}

Interaction effect of variety and harvesting time played a significant role on number of seeds pod^{-1} of pea too (Table 3). The maximum number of seeds pod^{-1} (6.34) was recorded in H_2V_4 which was statistically similar to H_1V_4, H_2V_2, H_2V_3, H_2V_5, H_2V_6, H_3V_2, H_3V_4, H_3V_6, H_4V_4 and H_4V_6 treatments. The minimum number of seeds (3.18 pod^{-1}) recorded at the treatment H_1V_1. The minimum number of seeds pod^{-1} in H_1V_1 might be due to the lack of proper time to grow and unfavorable environmental condition.

Pod yield (g plant^{-1})

Pod yield plant^{-1} was significantly influenced by the interaction effect of variety and harvesting time of the crop (Table 3). The treatment, H_2V_4 produced the maximum pod yield (22.84 g plant^{-1}) was statistically superior to the rest of treatments of pea. This might be due to plants of H_2 harvesting time received comparatively favorable environment and optimum time for vegetative growth of plant which lead to formation of higher photosynthetic products resulted in

higher pod yield plant^{-1}. The lowest pod yield (10.50 g pod^{-1}) produced by the treatment, H_1V_4. These findings are supported by Sachan *et al.* (2003) and Chandra and Polisetty (1998).

Table 2. Interaction effect of variety and harvesting time on pod length, pod breadth, pod yield and number of pods of pea

Treatments		Pod length (mm pod^{-1})	Pod breadth (mm pod^{-1})	Pod weight (g pod^{-1})	Number of pods plant^{-1}
H_1	V_1	41.57d	11.84a-d	3.09d-f	3.93c-e
	V_2	51.53a-d	11.73a-d	3.33b-f	4.31b-d
	V_3	48.21a-d	11.63a-e	3.23c-f	4.53a-d
	V_4	59.21a-d	10.47d-g	3.25b-f	3.24e
	V_5	59.39a-c	11.77a-d	3.07d-f	3.80de
	V_6	45.86b-d	9.72 gh	3.20c-f	3.93c-e
H_2	V_1	53.27a-d	12.19a-c	3.83a-d	4.50a-d
	V_2	58.86a-d	12.85ab	3.13d-f	4.88a-c
	V_3	52.01a-d	10.20f-h	3.63a-e	4.93a-c
	V_4	62.86ab	10.94c-g	4.05ab	5.47a
	V_5	58.46a-d	12.19a-c	4.13a	4.00c-e
	V_6	57.06a-d	10.27e-h	3.84a-d	5.06ab
H_3	V_1	44.44cd	12.40ab	3.64a-e	4.39b-d
	V_2	54.60a-d	12.35a-c	3.40a-f	4.77a-d
	V_3	47.50a-d	9.820gh	3.35a-f	4.67a-d
	V_4	59.68a-c	10.43d-g	3.58a-e	4.05b-e
	V_5	59.96a-c	12.07a-c	3.60a-e	4.15b-e
	V_6	63.68a	11.50b-f	3.63a-e	4.06b-e
H_4	V_1	43.02cd	12.37a-c	2.92ef	4.20b-e
	V_2	48.71a-d	13.06a	3.12d-f	4.67a-d
	V_3	43.05cd	9.03h	2.74f	4.38b-d
	V_4	56.56a-d	11.55b-f	3.04d-f	3.93c-e
	V_5	53.26a-d	12.71ab	3.93a-c	4.00c-e
	V_6	48.35a-d	10.93c-g	3.35a-f	3.95c-e
F value		0.45**	2.68**	1.29*	1.27*
CV (%)		16.70	6.50	11.87	12.27

H_1=30th January'09 (70 Days After Sowing), H_2= 9th February'09 (80 DAS), H_3=19th February'09 (90 DAS), H_4=1st March'09 (100 DAS), V_1=IPSA Motor shuti-1, V_2=IPSA Motor shuti-2, V_3=IPSA Motor shuti-3, V_4=BARI Motor shuti-1, V_5=BARI Motor shuti-3, V_6=Local white.
Means in a column followed by same letter(s) are not significantly different at 1 or 5 % level of significance.

Pod yield (t ha^{-1})

The interaction effect of variety and harvesting time on pod yield per hectare was significant (Table 3). The maximum pod yield (11.42 t ha^{-1}) was obtained from treatment H_2V_4 of pea which was statistically similar to H_2V_2 and H_2V_6 and superior to the rest of the treatments of pea. The lowest pod yield (5.25 t ha^{-1}) was produced by treatment H_1V_4. These findings are supported by Sachan *et al.* (2003) and Chandra and Polisetty (1998).

Seed yield pod^{-1} (g)

There was a significant interaction among the treatment combination in recording the weight of seeds pod^{-1} (Table 4). The maximum seed yield pod^{-1} (1.37 g pod^{-1}) was obtained by the treatment H_2V_1, H_2V_2 and H_4V_1 which were statistically superior to the treatments H_1V_1, H_1V_3,

H_1V_5, H_1V_6, H_3V_3, H_4V_3, H_4V_4, H_4V_5 and H_4V_6. The lowest seed yield pod^{-1} (1.02 g pod^{-1}) was obtained from H_4V_3.

Table 3. Interaction effect of variety and harvesting time on number of seeds pod^{-1} and pod yield of pea

Treatments		Number of seeds pod^{-1}	Pod yield (g plant^{-1})	Pod yield (t ha^{-1})
H_1	V_1	3.18d	12.15jk	6.02f-h
	V_2	4.31b-d	14.61h	7.31c-h
	V_3	4.18b-d	13.13ij	6.57d-h
	V_4	5.22ab	10.50l	5.25h
	V_5	3.40cd	11.54k	5.78gh
	V_6	4.53b-d	12.52i-k	6.26e-h
H_2	V_1	4.25b-d	17.06cd	8.53b-d
	V_2	5.11ab	20.08b	9.71ab
	V_3	5.48ab	17.82c	8.91bc
	V_4	6.34a	22.84a	11.42a
	V_5	4.80a-d	16.39de	8.19b-e
	V_6	6.24a	19.43b	9.72ab
H_3	V_1	4.01b-d	15.90e-g	8.62b-d
	V_2	5.01a-c	16.23d-f	8.12b-f
	V_3	4.58b-d	15.60e-h	7.80b-g
	V_4	5.04a-c	14.79h	7.39c-g
	V_5	4.00b-d	15.11gh	7.55c-g
	V_6	4.91a-c	14.79h	7.39c-g
H_4	V_1	3.90b-d	12.13i-k	6.06e-h
	V_2	4.25b-d	14.57h	7.28c-h
	V_3	4.17b-d	12.15i-k	6.07e-h
	V_4	5.26ab	11.89k	5.95gh
	V_5	3.93b-d	15.23f-h	6.85c-h
	V_6	4.75a-d	13.22i	6.62d-h
F value		0.31**	21.76**	1.61**
CV (%)		18.02	4.00	2.57

H_1=30th January'09 (70 Days After Sowing), H_2= 9th February'09 (80 DAS), H_3=19th February'09 (90 DAS), H_4=1st March'09 (100 DAS), V_1=IPSA Motor shuti-1, V_2=IPSA Motor shuti-2, V_3=IPSA Motor shuti-3, V_4=BARI Motor shuti-1, V_5=BARI Motor shuti-3, V_6=Local white.
Means in a column followed by same letter(s) are not significantly different at 1 % level of significance.

Seed yield plant^{-1} (g)

The interaction among varieties and harvesting time on the seed yield plant^{-1} was found to be significant (Table 4). The combination H_2V_4 produced the maximum seed yield (8.01 g plant^{-1}) of pea which was statistically superior to the rest of the treatments of the crop. This might be due to plants of H_2 received comparatively favorable environment and optimum time for vegetative growth of plant which leads to formation of higher photosynthetic products resulted in higher seed yield plant^{-1}. The lowest yield of seeds (4.12 g plant^{-1}) was obtained from treatment H_1V_5.

1000-seed weight (g)

Thousand seed weight was found significant among the treatment combination of varieties and harvesting time of the crop (Table 4). However, the 1000-seed weight found increased up to 300.00 g from the treatment H_2V_2 which was statistically similar to H_2V_6, H_3V_2 and H_4V_2 and superior to the rest of the treatments. The lowest thousand seed weight was from treatment, H_4V_3 and H_4V_5 and it was 170.00 g.

Seed yield (t ha^{-1})

Interaction effect significantly influenced the seed yield of pea (Table 4). The highest seed yield (4.00 t ha^{-1}) was obtained in treatment, H_2V_4 and it was statistically similar to the treatments, H_2V_2, H_2V_5 and H_2V_6 and superior to the rest of the treatments. The lowest seed yield was (2.06 t ha^{-1}) by the treatment, H_1V_5 of pea.

Table 4. Interaction effect of variety and harvesting time on 1000-seed weight and seed yield of pea

Treatments		Seed yield pod^{-1} (g)	Seed yield plant^{-1} (g)	1000-seed weight (g)	Seed Yield (t ha^{-1})
H_1	V_1	1.15b-e	215.00f-h	215.00f-h	2.50h-k
	V_2	1.22a-d	260.00b-d	260.00b-d	2.82e-h
	V_3	1.06de	180.00ij	180.00ij	2.75f-i
	V_4	1.19a-e	230.00d-g	230.00d-g	2.17jk
	V_5	1.15b-e	190.00h-j	190.00h-j	2.06k
	V_6	1.18b-e	220.00e-h	220.00e-h	2.56g-j
H_2	V_1	1.37a	250.00b-e	250.00b-e	3.28b-e
	V_2	1.37a	300.00a	300.00a	3.64ab
	V_3	1.24a-c	203.30g-j	203.30g-j	3.30b-e
	V_4	1.36a	265.00bc	265.00bc	4.00a
	V_5	1.32ab	200.00g-j	200.00g-j	3.87a
	V_6	1.32ab	280.00ab	280.00ab	3.59a-c
H_3	V_1	1.25a-c	230.00d-g	230.00d-g	2.99d-g
	V_2	1.32ab	280.00ab	280.00ab	3.34b-d
	V_3	1.15b-e	190.00h-j	190.00h-j	2.92d-h
	V_4	1.25a-c	250.00b-e	250.00b-e	3.00d-g
	V_5	1.21a-d	190.00h-j	190.00h-j	2.68f-i
	V_6	1.22a-d	240.00c-f	240.00c-f	2.74f-i
H_4	V_1	1.37a	215.00f-h	215.00f-h	2.52g-k
	V_2	1.20a-d	275.00ab	275.00ab	3.15c-f
	V_3	1.02e	170.00j	170.00j	2.47h-k
	V_4	1.10c-e	210.00f-i	210.00f-i	3.07d-f
	V_5	1.05de	170.00 j	170.00 j	2.30i-k
	V_6	1.15b-e	210.00f-i	210.00f-i	2.50h-k
F value		1.11*	82.51**	0.86**	3.47**
CV (%)		7.41	1.56	7.84	8.52

H_1=30th January'09 (70 Days After Sowing), H_2= 9th February'09 (80 DAS), H_3=19th February'09 (90 DAS), H_4=1st March'09 (100 DAS), V_1=IPSA Motor shuti-1, V_2=IPSA Motor shuti-2, V_3=IPSA Motor shuti-3, V_4=BARI Motor shuti-1, V_5=BARI Motor shuti-3, V_6=Local white.
Means in a column followed by same letter(s) are not significantly different at 1 or 5 % level of significance.

Table 5. Prevailing temperature, relative humidity and rainfall during the growing period of Pea during 2008-09

Month	Air Temperature (°C)			Humidity (%)	Rainfall (mm)
	Max.	Min.	Ave.		
November'08	26.2	23.7	25.0	87.7	035.8
December'08	22.0	19.4	20.6	84.2	000.0
January,09	19.9	17.6	18.7	84.0	029.6
February,09	20.5	17.8	19.2	85.0	064.3
March,09	26.2	23.5	24.8	83.6	015.0
April,09	30.0	28.6	28.2	76.2	010.4

Conclusion

All the varieties of garden pea (IPSA Motor shuti-1, IPSA Motor shuti-2, IPSA Motor shuti-3, BARI Motor shuti-1, BARI Motor shuti-3 and Local white) showed better performance for harvesting at 9th February'09 (80 DAS) in case of pod yield and seed yield. So, it can be concluded that, these six varieties should be sown on November 20 and harvested at 80 DAS to obtain higher pod and seed yield.

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