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Study of Some Important Morpho-Physiological Feature and Yield Attributes In Three Pea Genotypes

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Abstract: ***The experiment was carried out in the field of Bangladesh Institution of Nuclear Agriculture (BINA), Mymensingh, during the period from 15 November 2012 to 10 March 2013 to study the morpho-physiological characters, yield and yield attributes of three genotypes of pea, viz.; Exotic-1, IPSA-2 and IPSA-3.The experiment was conducted in a Randomized Complete Block Design with seven replications. Data were collected at 20,40,60,80,108 and 115 days after sowing (DAS).Varieties showed significant differences in plant height, branch number, leaf area, fresh and weights of roots, chlorophyll, aminoacid, soluble protein content, number of pods/plant, 1000- seed weight, pod size, harvest index and pod yield at harvest. Among the varieties, IPSA-3attained the plant height, leaf area, fresh and weights of roots, amino acid, protein and chlorophyll content.Exotic-1 had the lowest protein content in leaf, highest pods weight/plant, 1000-seed weight, harvest index, pod and seed yield. Exotic-1 had higher yield than the other two genotypes.***

Keywords: Pea, Morpho-physiological characteristics, Randomize Complete Block Design, Yield attribute

1. Introduction

The garden (*Pisumsativum* L.) is a widely grown legume belonging to the subfamily of Papilionaceae under the family Leguminosae. It is probably originated in southern Asia but is one of the important legume vegetables in Bangladesh and mostly grown for garden pods and seeds. The crop becomes popular for its high nutritive value and good taste. It contains 13-35% protein, 25-50% starch, 4-10% sugar, 0.6-1.5% fat and 2-4% minerals [12]. Globally, 8.06 million hectare of crop land was covered by peas with a production of 15 million metric tons in 1999 [6]. People in Bangladesh consume 23g vegetables per head per day but the minimum requirement is 200g per head per day [16]. Being a legume, pea has unique ability to fix atmospheric nitrogen through symbiosis. Field pea can fix about 64 kg nitrogen per hectare per annum [1]. Bangladesh soils are generally poor in nitrogen and organic matter. The incorporation of legume crops including field pea in the cropping pattern of such soils can help to maintain equilibrium when the nitrogen is fixed through Rhizobia at root zone and the organic matter deposited through crop residues. The agro ecological condition of Bangladesh is favorable for the cultivation of this crop. Field pea can be grown in rabi season. It takes about 45 to 50 days for showing for its green pod harvest and 90 to 100 days for mature seed harvest. Pea research in Bangladesh has been neglected [10]. Over the past decades, there has been a dramatic improvement in the yield of cereal grains. This was achieved by manipulation of the genetic makeup and physiological characteristics of these crops. Optimum density and row spacing are essential for attaining desired yield also [11]. Before going develop good high yielding varieties of peas, it is necessary to select the morpho-physiologically better characters to be incorporated in the future during the development of the pea cultivars. With this aim in view, the present experiment was conducted to study some important morphological features, investigate some physiological attributes and envisage yield attributes in three pea genotypes.The present investigation was designed to select some morpho-physiological and yield parameters responsible for higher yield of peas and be helpful to develop high yielding varieties.

2. Material and Methods

The experiment was conducted at the Bangladesh Institute of Nuclear Agriculture farm, Mymensingh, geographically it located at 24º75′N latitude and 90 º 50′E longitudes at the elevation of 18m above the seas level [7]. The land was further ploughed and cross ploughed several timed followed by laddering until a good tilth was achieved. After ploughing and laddering, weeds and stubbleswere collected and remove from the field during field preparation. Urea, TSP, and Muriate of Potash (MP) were applied to the plots as a source of nitrogen, phosphorus and potassium, respectively. Cow dung was also applied to the soil. Seeds of exotic line were collected from BINA, Mymensingh and IPSA from BSMARU, Gazipur. Seeds were sown by hand at 3 cm depth at a spacing of 25×10 cm. Germination of seeds was examined in the laboratory before showing in the field to ensure proper population in the plot before showing in the field. Thinning was done after 7 days of emergence for keeping desired plant density and to avoid competition. Weeding and irrigation were done as and when needed. The sample plants were harvested at three different times at 20, 40 and 60 days after showing (DAS). Theseplants were uprooted carefully to investigate rooting and shooting characteristics. Flower and pod production and percentage of floral abscission were estimated at 60, 80 and 100 DAS following the method of Fakir [5]. Chlorophyll in leaves by HG-AAS, soluble protein by UV-VIS spectrophotometer was determined. Total nitrogen content by Kjiedahl method and total Ca, Mg, and K were determined by Di-acid

digestion method [21]. Height of the plant was measured by meter scale. The mean differencesof the morphological, physiological and biological parameters among the treatments were adjusted by Ducan's Multiple Range Tests [8].

3. Result and discussion

3.1 Morphological characteristics

3.1.1 Plant height

Plant height varied significantly at different days after sowing (DAS) among the varieties.At 20 DAS, the tallest plant (13.04 cm) was observed in IPSA-3 and the shortest plant was recorded in Exotic-1(9.09 cm) which was statically similar to IPSA-2(9.117 cm). At 40 DAS, the tallest plant (34.26 cm) was found again in IPSA-3 which was statistically different from other varieties. The second highest plant (30.21 cm) was observed in IPSA-2 and the shortest plant was found in Exotic-1(19.78 cm) (Table 5). At 60 DAS, the tallest plant (42.74 cm) was obtained in IPSA-3 which was statistically different from Exotic-1.It was evident that plant height significantly differed from variety to variety. Rahman [15] also observed a quite high degree of variability in plant height among different pea varieties.

3.1.2 Number of branches per plant

At 20 DAS, the higher branch per plant was observed in Exotic-1than IPSA-3. At 40 DAS, the maximum branches per plant were obtained in IPSA-2(2.40) which was statically similar to IPSA-3 but different from Exotic-1.At 60 DAS, the higher branches per plant (3.10) were observed in Exotic-1 than IPSA-3(2.74). Akhter [3] also noted differences in branch number in varieties.

3.1.3 Number of leaves per plant

The maximum number of leaves per plant was obtained in IPSA-3 in all sampling dates. At 20 DAS, the greater number of leaves per plant was observed in IPSA-3(13.17) compared to IPSA-2 (10.71) and Exotic-1(9.35).The second highest number of leaves per plant was obtained in IPSA-2 and the lowest number of leaves per plant was obtained in IPSA-2 and the lowest number of leaves per plant was found in Exotic-1.

3.1.4 Leaf area

Leaf area was smaller in Exotic-1than in the other varieties between 40 and 60 DAS. Leaf area increased from 220 cm^2 at 40 DAS to 500 cm^2 at 60 DAS in IPSA-2 and from 297 cm^2 at 40 DAS to 601 cm^2 at 60 DAS in IPSA-3.Varietal differences in garden pea in leaf area were also reported by Akhter [3].

3.1.5 Fresh weight of roots

Results showed that fresh root weight in all varieties increased with the advancement of time. At 20 DAS, there were little differences in fresh root weight between the varieties. At 40 DAS, the fresh root weight was greater in Exotic-1(6.9 g) than IPSA-3(5.61 g) and IPSA-2 (4.70 g).At 60 DAS, fresh weight of root was greater in IPSA-3 than in the others.

3.1.6 Dry weight of roots

At 20 DAS, there was little variation in root dry weight. At 40 DAS, root dry weight was greater in IPSA-3 (1.21 g) than in the others (average of .78 g).At 60 DAS, the root dry weight was greater in IPSA-3(1.32) then others genotypes. Variation in root dry weight might be due to the difference in their genetic make-up. Sawatsky and Soper [17] observed different dry weight in pea varieties.

3.1.7 Number of noule

Number of noule/plant was recorded at different stages of plant growth (20, 40, 60 DAS).At all growth stages, nodule number was significantly high in Exotic-1, medium in IPSA-2 and low in IPSA-3.At 20 DAS, number of noule/plant was 185 in Exotic-1, 160 in IPSA-2 and 147 in IPSA-3.The trend was being similar at 40 and 60 DAS.

3.1.8 Pod length

The longer pod was observed in Exotic-1(8.12 cm) than IPSA-2 and IPSA-3 (average 6.25) (Table 3). Rahman [15] observed similar result in different types of pea.

3.1.9 Seed per pod

The higher number of seeds per pod was also observed in Exotic-1(5.01) than in IPSA-2 and IPSA-3(average 4.385) (Table 3).Similar results were also reported by Silimet al. [18] in field pea.

3.1.10 thousand seed weight

Exotic-1 had highest seed weight (28.00 g) which was significantly different IPSA-2 (19.20 g)(Table 3).Singh and Yadav (1989) also reported higher 1000-seed weight in lower plant density, which is agreement with the present findings. Similar results are shown by Miah [13].

3.1.11 Total dry mass

Total dry mass was significantly influenced by varieties (Table 3). IPSA-2 had smaller TDM than in the others. The lowest TDM was obtained in IPSA-2 (14.59 g).

3.2 Physiological characteristics

3.2.1 Chlorophyll-a

Chlorophyll – a (at 645 nm) was significantly influenced by varieties(Table 1).At 40 DAS, the chorophyll –a content (1.78 mg/gfw) was greater in IPSA-3 than in the IPSA-2 and Exotic-1. Similar result was observed by Akhter [3].

3.2.2 Chlorophyll-b

At 40 DAS, the highestChlorophyll –b content (0.61 mg/g fw) was found in IPSA-3 which was statically different from IPSA-2 (0.5 mg/g fw) and Exotic-1 (0.4 mg/gfw)(Table 1). The intermediate Chlorophyll –b content was obtained in IPSA-2 (0.5 mg/g fw) and the lowest Chlorophyll –b content was found in Exotic-1. Similar result was observed by Akhter [3].

3.2.3 Soluble protein content

Exotic-1 had lower protein content (8.8 mg/g) than in the IPSA-3 and IPSA-2 (9.45 mg/g) (Table 2). Halt [9] reported that protein content varied in different types of pea.

Table 1: Chlorophyll content in three pea genotypes

Variety	Chlorophyll-a (mg/g)	Chlorophyll-b (mg/g)
Exotic-1	1.550c	0.410c
IPSA-2	1.636b	0.500b
IPSA-3	1.7890a	0.616a
LSD 0.05	0.117	0.0117

In each column, figures bearing uncommon letter are significantly different at $p \leq 0.05$ by DMRT.

Table 2: Soluble protein and Amino acid content in leaves in three pea genotypes

Variety	Soluble protein in leaf (mg/g)	Amino acid (mg/g)
Exotic-1	8.810b	6.64b
IPSA-2	9.430a	6.69b
IPSA-3	9.580a	11.99a
LSD 0.05	0.912	0.4183

In each column, figures bearing uncommon letter are significantly different at $p \leq 0.05$ by DMRT.

Table 3: Yield and yield contributing characters of three pea genotypes

Variety	*Pod/plant (no.)*	*Pod size (cm)*	*Pod length (cm)*	*Seed/pod (no.)*	*1000 seed weight (g)*	*Pod yield/plant*	*Seed yield/plant*	*Total dry mass/plant*
Exotic-1	11.02a	0.60a	8.12a	5.01a	28.00a	15.10a	6.89a	16.08a
IPSA-2	7.06c	0.40c	6.20b	4.55b	19.50b	12.50c	5.71c	14.59b
IPSA-3	10.01b	0.50b	6.30b	4.62b	13.20c	13.62b	6.21b	16.02a
LSD 0.05	0.549	0.012	0.539	0.244	1.553	0.760	0.453	1.027

In each column, figures bearing uncommon letter are significantly different at $p \leq 0.05$ by DMRT.

Table 4: Number of flower, abscission (%) and number of pod per plant at 60 DAS in three pea genotypes

Variety	*Total no. of flower*	*Abscission (%)*	*Pod/plant*
Exotic-1	22.01a	50.19b	11.01a
IPSA-2	16.0c	54.0a	7.04c
IPSA-3	20.0b	53.01a	10.0b
LSD 0.05	1.553	2.745	0.776

In each column, figures bearing uncommon letter are significantly different at $p \leq 0.05$ by DMRT.

Table 5: Days to 50% germination and plant height at harvest in three pea genotypes.

Variety	Days to 50% germination	Plant height at harvest
Exotic-1	6.01a	50.11b
IPSA-2	5.44b	50.00b
IPSA-3	5.96a	65.01a
LSD 0.05	0.271	1.941

In each column, figures bearing uncommon letter are significantly different at $p \leq 0.05$ by DMRT.

Table 6: Number of days required for 50% flowering, days to 50% pod set and days to 90% pod maturity in three pea varieties.

Variety	Days to 50% flowering	Days to 50% pod set	Days to 90% pod maturity
Exotic-1	70.01a	80.01a	115.01a
IPSA-2	58.11c	64.02c	81.01c
IPSA-3	64.22b	70.12b	101.22b
LSD 0.05	3.882	5.823	9.509

In each column, figures bearing uncommon letter are significantly different at $p \leq 0.05$ by DMRT.

Table 7: N, K, Ca and Mg contents in pea genotypes.

Variety	*N content (%)*	*K content (mg/g)*	*Ca content (mg/g)*	*Mg content (mg/g)*
Exotic-1	3.76	1.29a	0.15a	0.16a
IPSA-2	3.65	1.08b	0.11b	0.11b
IPSA-3	3.61	1.06b	0.10b	0.10b
LSD 0.05	NS	0.074	0.012	0.017

In each column, figures bearing uncommon letter are significantly different at $p \leq 0.05$ by DMRT. NS= Not significant

3.2.4 Amino acid content

The amount of amino acid in IPSA-3 (11.99) was greater IPSA-2 and Exotic-1(average of 6.72) (Table 2).

3.2.5 Sugar content

Significantly higher amount of sugar was found in Exotic-1 (0.52 mg/g fw) than in IPSA-3 and in IPSA-2 (0.41 mg/g fw). Similar result was observed by Akhter[3].

3.2.6 Protein content in grain

The protein content was greater in Exotic-1 (24.05 mg/g) than IPSA-2 (22.71 mg/g) and IPSA-3 (19.5 mg/g).Protein content increased with the delay in sowing of pea was reported by Ekeberg [4].

3.2.7 Number of total pods per plant

Exotic-1 produced the higher total pods/plant (11.02) than IPSA-3 (10.01) and IPSA-2 (7.06)(Table 3).Singh and Yadav (1989) reported that increased number of pods per plant was recorded due to decrease in planting density.Variation in pod yield between varieties was observed [20].

3.2.8 Flower and pod production and abscission

The flower production was high in Exotic-1 (22.01), medium in IPSA-3 (20.0) and low in IPSA-2 (16.0).The minimum percentage of abscission of flowers was obtained in Exotic-1 (50.19)(Table 4).Thus the increased number of flowers and decreased percentage of floral abscissionproduced the greater number of pods in Exotic-1.

3.2.9 Days of 50% germination and plant height at harvest

Exotic-1 required maximum period (6.01 days) which was statistically similar with IPSA-3 (5.96 days).The minimum period (5.44 days) was needed in IPSA-2(Table 6). Rahman [15] observed similar result in IPSA-2 and IPSA-3 genotypes.

3.2.10 Phenology

IPSA-2 flowered earlier (58 days) than IPSA-3 (64) and Exotic-1(70 days).The genotypes IPSA-2 and IPSA-3 matured one or two weeks earlier than Exotic-1. IPSA-2 showed 50% pod set at 60 DAS followed by IPSA-3 (70 DAS) and Exotic-1(80 DAS).The genotype IPSA-2 and Exotic-1showed 90% pod maturity at 81, 101 and 115 DAS, respectively (Table 6).

3.2.11 N, Ca, Mg and K content of green seed

The highest amount of N (3.76%) were recorded in Exotic-1which was statistically similar with IPSA-2 (3.65%) IPSA-3 (3.61%) (Table 7).Similar result was observed by Rahman [15]. The amount of K was higher in Exotics-1(1.29%) than IPSA-2 (1.08%) and IPSA-3 (1.06%) (Table 7).The maximum Ca was found in Exotic-1 (0.15%) which was not statistically similar with IPSA-2(0.11%) and IPSA-3(0.10%) (Table 7). The intermediate Ca content was obtained in IPSA-2 and the lowest was obtained in IPSA-3.Exotic-1 possessed the higher Mg (0.16%) than IPSA-2(0.11%) and IPSA-3(0.10%) (Table 7).

4. Conclusion

The mean performances of the varieties under the study differed significantly.The yield contributing parameter like number of pod per plant, yield per plant, 1000-seed weight, harvest index were the highest in Exotic-1. Among the varieties, Exotic-1 showed its superiority in respect of these parameters over the other varieties. The performance of Exotic-1 was the best in respect of pod weight per plant. From the above results, it could be concluded that Exotic-1 is the short statured plant with higher pod and seed yield among the studied genotypes. However, further studies are necessary to arrive at a definite conclusion.

5. Future Scope of this Study

This study may provide great information to select pea genotype for cultivation. New researchers who interested to study at pea genotype this study may helpful to them.

References

[1] N. Ahmed, Bangladesh Dal Chasherpanthpanzi, 1st Edn. FAO/ UNDP project (Bangladesh. Pub. 1. pp. 25-28), 1984.
[2] S.V. Akbar, Zaki and S. Hayat, Effect of different planting dates on the performance of peas in awat valley, Sorrhad, J. Agric. Sci. 16(1): 29-31, 2000.
[3] N. Akhter, Morphological change of garden pea (*Pisumsativum* L.) under different reducing light level.M.S Thesis, Dept. Crop Bot. BSMRAU, Gagipur, Bangladesh, 2004.
[4] E. Ekeberg, Trails with different showing dates in 1985-1989, NorskLandbruks forsaking, 8(2): 156-175, 1994.
[5] M.S.A. Fakir, P. Umaharan, and C.R. McDavid, A modified method for estimating floral abseission in pigeonpea, Trop. Agric. (Trinidad), 75(3): 393-395, 1998.
[6] FAO (Food and agricultural Organization), Production year book.Food and Agricultural Organization of the United Nations, Rome, Italy. 42: 190-193, 2000.
[7] FAO (Food and Agricultural Organization), Land Resources Appraisal Bangladesh Agric. Dev. Report 2, Agroecological regions of Bangladesh, pp.212-221, 1998.
[8] K.A. Gomez, and A.A. Gomez, Statistical Procedures for Agriculture Research, 2ndEdn.John Wiley and Sons, New York, p. 6401984.
[9] Halt, Amino acid composition and protein quality of field peas, Can. J. plant Sci. 59: 653-660, 1979.
[10] A.K. Kaul, and C.I.L. Gowda, Pulses in BD, BARI, Joydebpur and FAO, pp. 1-201, 1982.
[11] D.R. Mackenzie, N.C. Chen, T.D. Lion, B.P. Wuherry, and F.B. Oyer, Response of munghbean, Wilezerk and Soyabean to increasing plant density, J. Amer. Soc. Hort. Sci. 100: 579-583, 1975.
[12] R. Makasheva, Nutritional value of pea. Plenum press, New York, pp.605-640, 1983.
[13] M.A.K. Miah, Three improve variety of pea, ISPA Motoshoty 1,2,3 out research programe, BSMRAU, Gazipur, pp. 1-5, 1999.
[14] R. Niwas, Kumar and V.P. Singh, Phenotypic Stability of pea (*Pisiumsativum* L.) genotypes for yield and its components charakters, Intl. J. Agric. 11(1): 52-56, 1993.
[15] F. Rahman, Effect of sowing time and population density on the growth, yield and quality of garden pea, A M.S Thesis, Dept. Agron. BSMRAU, Gazipur, Bangladesh, 2001.
[16] A.M. Rashid, Vegetables National Book Trust India, 1993.
[17] N. Sawatsky, and R.J. Soper, A quantitative measurement of the nitrogen loss from the root system of field peas (*Pisumsativum* L.)grown in the soil, Soil Biol. Biochem. 23(3): 255-259, 1991.
[18] S.N. Silim, P.D. Hebblethwaite, and C. James, Irrigation and water use in leaf less peas, J. Agric. Sci. 119: 211-222, 1992.
[19] V.K. Singh, and P.S. Yadav, Effect of sowing dates and plant density on dwarf peas, Indian J. Agron. 34 (1): 92-95, 1989.
[20] D, Stelling, E. Ebmeyer, and B. Snod, Selection in early generations of dried pea (*Pisumsativum* L.), Significance of the environment of selection, Plant breed, 105(3): 180-188, 1990.
[21] Yamakawa, Minerals measurement with the folin-pheno reagent, J. Bio. Chem. 189: 240-260, 1992.

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