Pakistan J. Agric. Res. Vol. 29 No. 4, 2016

EVALUATION OF DIFFERENT PEA (PISUM SATIVUM L.) GENOTYPES FOR YIELD AND OTHER ATTRIBUTES AT SHINKIARI, MANSEHRA

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ABSTRACT:- The present research work was designed to find out the amount of genetic variability that may exist in different pea cultivars. For this purpose six advance lines/commercial pea varieties were collected from Ayub Agricultural Research Institute (AARI) Faisalabad and one local variety was included in the experiment as a control. The experiment was conducted during 2014-15 at National Tea & High Value Crops Research Institute (NTHRI) Shinkiari, Mansehra. Altogether seven pea genotypes were laid out in Randomized Complete Block Design (RCBD) with three replications. Normal agronomic practices were carried out during the growth period and data was recorded on different growth parameters. Significant differences were observed for all the agronomic traits studied. Root rot attack was observed during the growth period. Pea variety 'Meteor' was found susceptible against this disease followed by 'Sarsabz 9800-1' as moderately susceptible and 9375 as resistant. The other varieties/lines Pea-09, Climax, Local and PF-400 were found tolerant against this disease. Green pod yield per hectare data revealed that pea variety 'Climax' produced the highest yield (11.6 t ha-1) followed by advance lines PF-400 (11.5 t ha-1) and 9375 (9.9 t ha-1), respectively. The lowest yield (2.1 t ha-1) was recorded for 'Meteor' which was also found susceptible against root rot disease. Based on our findings, it is recommended that pea variety 'Climax' cultivation should be promoted in the area at large scale in order to increase the production and give more financial benefits to the farmers of the area. Advance lines PF-400 & 9375 which performed well in the experiment and bear bright future prospects should be considered in designing future hybridization programs.

Key Words: Pea, genetic variability, growth parameters, genotypes, root rot, advance line, breeding program, hybridization.

INTRODUCTION

Peas (*Pisum sativum* L.) a grain legume, a member of the leguminoseae family and native of central or South east Asia, is an excellent human food. It is either eaten as a vegetable or used in the preparation of soups. In addition to that it is also used as animal feed. Kevin McPhee (2003) has reported that pea seed is highly nutritious and approximately half the world production is fed to livestock while the remaining portion is used for human food, primarily in developing counties. The peas are full of nutrition because its grain is rich in protein (27.8%), complex carbohydrates (42.65%), vitamins, minerals, dietary fibers and antioxidant compounds (Urbano et al., 2003). Among grain legumes Pea ranks 4th

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in the world on production basis after soybean, groundnut and French beans. Dry pea is produced in more than 87 countries worldwide with approximately one-half the world's production occurring in Canada, France, China and Russia. Other leading pea producing countries include India, Ukraine, Germany, Australia, United Kingdom and United States.

In Pakistan, pea is an important crop, which plays a major role in farmer's economy. It is the most common crop and enjoys a great commercial demand due to its nutritive value. It is cultivated during winter in plains and during summer in highlands (Habib and Zamin, 2003). It represents about 40% of the total trade in pulses. In 2011-12, the crop was grown over an area of 15.8 thousand hectares with 105 thousand tonnes production of green pea and average yield was 166 mounds ha-1 (Anonymous, 2012). In Pakistan it is cultivated under an extensive range of agricultural regions, but the average yield per hectare is very low as compared to its potential and yield obtained in many other countries. The diseases are the major important factors which influence the pea production. There are several pathogenic fungi which are most destructive and cause partial to complete loss of crop. Among them some important fungi's are *Cladosporium pisicola*, *Ascoch-yta pisi, Fusarium oxysporum, Scl-erotina sclerotiorum, Aphanomyces euteiches, Peronospora pisi, Botrytis cinerea, Erysiphe polygoni and Pythium spps*. Among these, *Fusarium oxysporum* is the most important and major soil borne pathogen in Pakistan. It is widely distributed throughout the country especially in Northern areas. It is estimated that about 50% losses of fruits, vegetables and field crops in the country are due to *Fusarium spp*. Successful application of the chemicals for disease control has not been reported so far. Introduction of resistant varieties will be optimum solution and in addition, disease escape strategy can be adapted by changing the location and time of harvest. Plantation on well drained soils and chemically treated seed will also help in disease reduction. Use of some bio-control agents such as *Trichoderma harzianum* and *Streptomyces spp*. has been proposed as a modern management strategy. Out of many constrains which limit the pea economical crop growth, the main hindering factor is improper combination of different chemical fertilizers. Achakzai & Bangulzai (2006) has obtained maximum fresh pod yield i.e., 11908.50 kg ha^{-1} when they applied NPK @ 100:60:40 kg ha^{-1}.

As compared to many other countries, the average yield of pea crop is very low in Pakistan which may be attributed due to the non-adoption of improved varieties. Santalla et al. (2001) have also reported that variability in old, unimproved varieties needs to be determined in order to create useful genetic variation for broadening the narrow genetic base of commercial cultivars and for making efficient use of available resources. The other factors like non usage of recommended agronomic practices, application of improper fertilizer doses; diseases and harvesting losses also play an important role in yield reduction. According to Khan et al. (2003) the main hurdle in the way of increasing per hectare pea production is the weed competition. Sometimes season long crop-weed competitions reduce the green pod yield by up to 45-55% (Prakash et al. 2000). In addition to these, environ-

mental factor such as rainfall also affects yield. McPhee and Muehlbauer (2001) have also reported that seed yield in pea is highly dependent on environment and is particularly responsive to the amount and distribution of precipitation received during the growing season.

Keeping all these issues in view, present research work was designed to evaluate the available material for yield other agronomic traits and also to observe their performance against prevailing diseases under the local climatic conditions. Availability of genetic variability is crucial for any breeding program which provides opportunity for selection of desirable genotypes. Gupta et al. (2006) have also reported about existence of considerable amount of genetic variability in pea. Based on our findings, high yielding disease resistant variety will be recommended for cultivation in the area and in addition to this future hybridization strategies will be designed.

MATERIALS AND METHODS

An experiment was conducted at National Tea & High Value Crops Research Institute Shinkiari, Mansehra during 2014-15. The material was obtained from Ayub Agriculture Research Institute (AARI) Faisalabad. Seven entries; including one local variety used in the experiment as check, was laid out in randomized complete block design (RCBD) with three replic-ations. Each entry was sown in two rows. Row length was 3 m and distance between 2 rows was kept as 30 cm. Normal agronomic practices were carried out during the growth period and recommended dose of fertilizer was applied for the better nourishment of plants. Data was recorded on seed germination percentage, days to 50% flowering, plant vigor (varieties/lines with 81-100% growth was ranked as 1, with 71-80% growth was ranked as 2, with 61-70% growth was ranked as 3, with 51-60% growth was ranked as 4 and with 50% and below growth was ranked as 5), plant height (cm), green pod yield (t ha-1) and 100 seed weight (gm). Keeping the damage intensity in view, experimental material was also screened against diseases prevailing under natural climatic conditions by scoring 1 for tolerant, 3 for resistant, 5 for mode-rately susceptible, 7 for susceptible and 9 for highly susceptible. The recorded data was subjected to the analysis of variance technique and the significant means were subsequently separated by the LSD test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

In order to explore the potential genetic variability that may exist in the experimental material, data was recorded on various growth parameters i.e. seed germination percentage, days to 50% flowering, plant vigor, plant height, green pod yield and 100 seed weight respectively. Significant association between these traits has been reported by Kumar & Sharma (2006). Statistical analysis showed significant differences for all agronomic parameters studied (Table 1). Similar findings were reported by Akansha et al. (2011) that analysis of variance reveals significant differences for most of the characters studied in pea experiment.

Significant differences were observed in the tested material for seed germination percentage. Pea variety Meteor stood at par among the seven tested genotypes having

Table 1. Agronomic data of some quantitative parameters and disease status of different pea varieties

S. No	Variety	Seed Germination (%age)	Days to 50% Flowering	Plant Vigor	Plant Height (cm)	Green Pod Yield (t ha^{-1})	100 Seed Weight (gm)	Disease Status
1.	Pea-09	70^{AB}	61^{C}	3.5^{AB}	40.6^{C}	02.2^{C}	15.7^{CD}	Tolerant
2.	Climax	86^{AB}	84^{B}	1.0^{C}	34.3^{D}	11.6^{A}	15.6^{CD}	Tolerant
3.	Meteor	90^{A}	61^{C}	3.5^{AB}	48.4^{A}	02.1^{C}	14.9^{D}	Susceptible
4.	Local	40^{C}	109^{A}	2.0^{BC}	31.0^{E}	04.3^{BC}	13.4^{E}	Tolerant
5.	Sarsabz 9800-1	68^{AB}	63^{C}	4.0^{A}	43.2^{B}	03.1^{C}	19.5^{A}	Moderately Susceptible
6.	PF-400	62^{BC}	95^{AB}	1.5^{C}	42.8^{B}	11.5^{A}	16.5^{BC}	Tolerant
7.	9375	60^{BC}	100^{AB}	1.5^{C}	31.7^{E}	09.9^{AB}	17.7^{B}	Resistant
	$Lsd_{0.05}$	10.9	8.48	0.82	00.83	00.98	00.47	

maximum germination percentage of 90% followed by pea variety Climax having 86% germination. Four varieties/lines were fallen in intermediate group and seed germination percentage ranges from 60 to 70%. Pea-09 has 70%, Sarsabz 9800-1 68%, PF-400 62% and advance line 9375 has 60% germination percentage respectively. Germination of the local variety was poorest among all genotypes by having 40% germination only. Muehlbauer and McPhee (1997) have reported that seed germination is affected by physiological age of the seed at harvest and subsequent handling. In addition to this, harvesting time, harvesting, threshing methods and storage conditions also affect the seed viability (Castillo et aI., 1992). Contrary to our findings, non-significant differences were observed for seed germination by Amjad & Anjum (2002) when they evaluated nine pea cultivars under Faisalabad conditions.

Number of days required to attain 50% flowering data revealed significant differences among the tested genotypes. Recorded data ranged from 61 to 109 days determining wide range of duration required for different cultivars to attain flowering and subsequently significant effects on maturity. Makasheva (1983) also reported that pea cultivars have a sufficiently wide range of duration of vegetative period and their consequent phases (flowering, maturation etc.). Local variety took maximum days (109) in attaining 50% flowering followed by advance line 9375 and PF-400 by taking 100 and 95 days respectively, while pea variety Climax took only 84 days. The remaining varieties/lines were fallen in the same group by having minimum number of days required for 50% flowering i.e. Sarsabz 9800-1 (63), Pea-09 (61) & Meteor (61). The results will help in future hybridization program as well as in selecting desirable genotypes.

The experimental material exhibited significant differences in the field when data was recorded on plant vigor based on their vegetative growth. Varieties/lines with 81-100% plant vigor was marked excellent and

ranked as 1, with 71-80% plant vigor marked very good and ranked as 2, with 61-70% plant vigor marked good and ranked as 3, with 51-60% plant vigor marked average and ranked as 4 and marked poor with 50% and below plant vigor and ranked as 5. Muehlbauer and McPhee (1997) also reported that maximum yield requires maximum vegetative growth during the establishment of crop growth. Pea variety Climax was at par and have excellent plant vigor (1 C), followed by advance lines PF-400 & 9375 both were having very good plant vigor (1.5 C each). Local variety has good plant vigor only (2.0 BC). Average plant vigor was recorded for Pea-09 & Meteor respectively (3.5 AB each). The Sarsabz 9800-1 plant vigor was poorest among all by having (4.0 A) plant stand in the field.

Plant height data was recorded at the time when all genotypes have attained more than 90% maturity. Significant differences were recorded among the genotypes for this parameter as they belong to different genetic backgrounds. Million (2012) reported that significant variability existed for the traits studied in field pea genotypes and plant height is among those traits having positive and greater influence. Similar differences in plant height among different pea cultivars were reported by Gentry (1971). In our experiment data for plant height range from 31 cm to 48.4 cm. Maximum plant height (48.4 cm) was recorded for pea variety Meteor, followed by Sarsabz 9800-1, PF-400 and Pea-09 having 43.2 cm, 42.8 cm & 40.6 cm plants height respectively. Pea variety Climax was having 34.3cm plant height followed by advance line 9375 having 31.7 cm while lowest value for this parameter was recorded for local variety (31.0 cm). Pea variety Climax with medium plant height gave maximum fresh pod yield showing and proving that selection criteria should be based on this.

After attaining the full size, green pods were collected at regular intervals and data was recorded in each replication for different varieties / lines. Analyzed data reveals significant differences among all. Maximum green pod yield was recorded for pea variety Climax having 11.6 t ha-1 closely followed by advance lines PF-400 having 11.5 t ha-1 green pod yield respectively. Advance line 9375 stood 3rd having 9.9 t ha-1 yield and fall in the intermediate group. Poor performance for this parameter was recorded for local, Sarsabz 9800-1, Pea-09 and Meteor having 4.3 t ha-1, 3.1 t ha-1, 2.2 t ha-1 and 2.1 t ha-1 green pod yields respectively. Pea variety Climax which was at par for yield also exhibit excellent performance in the field for plant vigor, proving that vegetative growth plays an important role in the yield. In addition to this it shows tolerance against root rot disease. These results are in accordance with Ashraf et al. (2011) findings in which pea variety Climax gave better yield as compared to other variety in their experiment. Same result was reported by Achakzai & Bangulzai (2006). In their experiment pea variety Climax was at par out of four pea varieties when data was recorded on various growth parameters. The excellent performance of the same variety at various locations and in different time periods shows its great potential, wider adaptability and consistency. Contrary to our findings where pea variety Climax performed well and Meteor poorly, Murtaza et. al. (2007) has reported that Meteor gave maximum produc-

tion as compared to Climax in his experiment on pea.

Seed weight of 100 dried grains was recorded for each entry in each replication. Data revealed significant differences for all the genotypes under study. Nausherwan et al. (2008) has also observed significant differences for 100 seed weight along with other parameters in their experiment conducted on twelve pea genotypes. In our experiment data range from 13.4 gm recorded for local variety to 19.5 gm for Sarsabz 9800-1. Though highest seed weight value was recorded for Sarsabz 9800-1 which ranked 5th in green pod yield production and found moderately susceptible for root rot disease, hence proving that seed weight is not a good standard for selecting high yielding pea varieties. On the other hand, pea varieties-/lines with medium seed weight not only gave maximum yield production but also performed well for other yield attributing factors.

Root rot attack was observed on different pea varieties/lines during the growth period. Ali et al. (1993) has also reported that the root rot complex caused by different races (*Rhizoctonia solani, Fusarium solani, Aphanomyces euteiches, Pythium-ultimum and Fusarium oxysporum*) has been reported from all commercial pea growing areas of the world. Data was recorded by adopting international standard and varieties/lines with zero attack was ranked as tolerant (1), with minor attack as resistant (3), with low intensity as moderately susceptible (5), with medium intensity as susceptible (7) and with high intensity as highly susceptible (9). Recorded data revealed that the pea varieties/lines i.e. Pea-09, Climax, Local and PF-400 are tolerant, advance line 9375 as resis-tant, Sarsabz 9800-1 as moderately susceptible and Meteor as suscep-tible. Material found tolerant or resistant against disease also perfor-med well for other agronomic traits.

Significant differences were observed for all the parameters studied. Highest germination percentage was recorded for pea variety Meteor (90%) followed by Climax (86%) and Pea-09 (70%). Local variety took maximum number of days for 50% flowering (109) followed by line 9375 (100) and PF-400 (95) respectively. Based on vegetative growth, excellent performance was shown in the field by pea variety Climax, followed by advance lines PF-400 AND 9375. Plant height data revealed that pea variety Meteor has tallest plants (48.4 cm) followed by Sarsabz 9800-1 and PF-400 having plants with average plant height of 43.2 and 42.8 cm respectively. As far green pod yield data is concerned, commercial variety Climax (11.6 t.ha-1) was at par followed by advance lines PF-400 & 9375 having 11.5 t ha-1 and 9.9 t ha-1 respectively. Seed weight of 100 dried grains reveals that Sarsabz 9800-1 was at par followed by advance lines 9375 and PF-400. During the growth period, root rot attack was observed. Maximum infected plants were recorded in pea variety Meteor followed by Sarsabz 9800-1, whereas only few infected plant was recorded in advance line 9375 (Table 1).

Commercial variety Climax out yielded all other competitors by having excellent germination percentage, medium plant height and above of all found resistant against prevailing diseases. Similar performance was exhibited by advance line PF-400 followed by 9375. Based on our

findings, it is recommended that pea variety Climax is best choice for commercial cultivation and advance lines PF-400 & 9375, which performed well in the experiment for most of the agronomic parameters studied will be considered in future hybridization program.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

S.No	Author Name	Contribution to the paper
1.	Dr. Basharat Hussain Shah	Overall management of the article
2.	Dr. F. S. Hamid	Technical input at every step
3.	Mr. Shamas-ul-Islam	Data entry in SPSS and analysis
4.	Mr. Fayaz Ahmad	Concived the idea
5.	Mr. Sohail Aslam	Data collection
6.	Dr. Noorullah Khan	Wrote Abstract

(Received April 2016 and Accepted May 2016)