



Research Article

Effects of Different Combination of Fertilizer on Growth and Yield in *Plantago ovata* (Forsk.) Isapghol

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Abstract | *Plantago ovata* (Forsk.) is an important cash and medicinal crop belonging to Plantaginaceae family. Isapghol is popular in traditional and modern medicinal plants due to its pharmacological properties and placed in leading medicinal crop in worldwide. Research plot was located at Bahawalpur divisions at different location under (Pakistan Agriculture Research Council PARC), Arid Zone Research Institute in two crop seasons 2022–2023. Five different germplasm were used for the study 21213, 21474, 20617, 21260 and 21988. The study was carried out to calculate the effects of chemical plant fertilizer include N and P (chemical fertilizing system), animal manure (Farmyard Manure), combination with chemical fertilizer (also known integrated fertilizer) at clay loam soil of AZRI, Bahawalpur during 2022–2023. Each germplasm contained following treatments including control (C0) chemical, in C1 (30 P+50 N), C2 (15 P+25 N), organic matter; M2 (Cow Dung 10 t/ha) M1 (Cow Dung 20 t/ha), and integrated 1N2 C1 (5 P+10 N+10 Cow dung t/ha) and 1N1 (C1 10 P+20+N+20 Cow dung t/ha) were tested. The plot design was adopted RCBD (Randomize complete block design) with single row method for sowing with three replications. SL (Spike length) is non-significant and has negative effect with DFI (-0.1856), DF (0.2161), NTPP (0.6880), DM (-0.1100) and SYPP (0.5901). SYPP (Seed yield per plant) shows negative correlation with DFI (-0.4126), DF (-0.0489), and DM (-0.3370) and positive correlation with NTPP, NSPP, SL and PH. The mean DFI values differ across treatments, with C0 having the greatest mean (95.998) and IN2 is having the lowest mean (89.66). The F-Value (11.12) illustrates the difference in DFI among treatments. Yield is variable, with the highest mean in IN1 (501.50) and the lowest in C0 (295.08). F-Value (304.13) shows significant yield differences between treatments. P-value (0.0000) indicates statistical significance. This study is dependable for improvement of fertilizer distribution patterns in *Plantago ovata* production techniques.

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Introduction

Plantago ovata Forsk. Belonging to the Plantaginaceae family. genus consists of 200 species and only two species *P. ovata* and *P. psyllium* used as husk production. The husk of *P. ovata* known as in sub-continent/Hindi “isapghol” and in English “Blonde Psyllium” and “Psyllium” (Dhar *et al.*, 2005). The word Plantago is derived from Latin, meaning “Sole of the foot”, which refers to typically shape of the leaves, and species name of ovata is also referring to ovate shape of leaf. The isapghol is from Persian words, Isap and ghol meaning horse ear which are referring to its seed shape. Psyllium is a Greek word with meaning “Flea” which refers to shape, size and color of the seeds.

Plantago ovata is annual herbs in small size of temperate sandy zone which located 26° and 36° N latitudes, its species originated from West Asian region. It is distributed in Canary Island, North Africa, Southern Spain, the Middle East, Pakistan and Western India, Central Asia and Southern part of Soviet (Stebbins *et al.*, 1967).

Plantago ovata is stemmed, short herbs with length 10-50 cm (Jamwal, 2000). Leaves allocate alternately on the plant stem with 40- 86 counting on per plant. The leaf is strap-shaped, linear, 0.3-1.9 in width and 6.0-25.0 in length with a slightly pubescent surface. Spikes are glabrous, axillary and vary between 8-62 per plant. Flowers locate on the spikes in spiral rows. Seeds are translucent, cymbiform and concavo-convex. The convex side is covered by white membrane and thin in nature, while concave side is boat shaped in nature. The outer part of seed is holding seed husks which are tasteless and odorless (Hyde, 1970; Lamba and Gupta, 1981).

In the sub-continent *P. ovata* is grown as winter crop with 120-135 crop duration. Dry climatic conditions are best for the growth of the crop. Seeds are sown in late October to mid of December in 18-26° C temperature. The seeds are sown with broadcast method, deep burial of seed is avoided with seed rate 4-13 kg/ha (Mehta *et al.*, 1976).

P. ovata grown on a variety of soil textures, sandy loam, and well-drained soil is most suited for production and cultivation. Optimum condition for best growth pH is between 7.2-7.9 (Modi *et al.*, 1974).

Psyllium is used as a dietary fiber to promote stomach bowel functions and other (Cummings, 1993). This also regulates the blood cholesterol levels (Anderson *et al.*, 2000). The seed of *P. ovata* consist albuminous matter, mucilage oil, glucoside, aucubin and plantiose sugar (Chopra, 1930; Khorana *et al.*, 1958; French *et al.*, 1953). Seed oil held mainly two oxygenated-fatty acids 9-oxoactadeeocis-12enoic acid and 9-hydroxyactadec-cis-12-enoic acids (Jamal *et al.*, 1987). *P. ovata* used as a remedy for intestinal problems and chronic dysentery. Solution of gum's Plantago is thixotropic which have disintegrate properties (Jan *et al.*, 2020). The husk of seed is rosy-white membranous which used as medicinal purposes (Sutradhar *et al.*, 2022).

Materials and Methods

Research plot was found at Bahawalpur divisions at different location under Pakistan Agriculture Research Council (PARC) Arid Zone Research Institute in two crop seasons 2022-2023. The temperature of the field recorded is 6-41°C and humidity of seasons varies from 75 to 81 % and with Arid to semi-arid conditions.

The plots experiment soil was loamy sand in soil texture, with low nitrogen and organic carbon and medium in potash and slightly alkaline nature. The plot design was adopted RCBD (Randomize complete block design) with single row method for sowing with three replications. Each length was two meters with 30 plants and row to row distance was 45 cm. All agronomic practices recommended for the development of psyllium were practiced.

Genetical parameters were recorded on five randomly existing plants, the parameters included (DFI), (DF), (PH), (NTPP), (NSPP), (SPL), (DM) and (SYPP). Sampling was done on every stage of growth of plant genotypic and phenotypic characteristics. *P. ovata* has a very narrow genetic base with little inbuilt variability. Plant stand was calculated number of healthy plants per square meter. Days to flower initiation observed time duration from sowing to the appearance of the first flower. The time it took for half of the plants to start flowering is measured to days to 50% flowering stage. The plant population per meter used as number of plants. The length of the plant was measured in cm as plant height. Spikes per plant were counted on individual plants.

Table 1: ANOVA for fertilizer means.

Treat-ments	DFI	50% DFI	No. tillers/plant	No. Spikes/plant	Spike length (cm)	Plant height (cm)	Days to maturity	Yield (kg/ha)
C0	95.99±1.13a	103.93±0.99c	2.20±0.13d	10.40±0.24bc	2.29±0.081d	14.00±0.70a	129.00±0.23a	295.08±1.26e
C1	93.80±0.34abc	108.80±0.54a	2.7140±0.22cd	11.63±0.74bc	2.71±0.046cd	14.84±0.85bc	126.47±0.75b	343.46±2.38d
C2	88.13±0.34d	104.33±0.45bc	2.77±0.13cd	10.23±0.29bc	3.03±0.13bc	15.86±0.27abc	125.27±0.58b	339.38±5.09d
M0	94.13±0.48abc	105.00±0.55bc	2.50±0.11cd	9.53±0.27c	3.00±0.29bcd	16.08±0.23abc	125.93±0.37b	301.49±0.93e
M1	95.39±0.26ab	106.33±0.60abc	3.04±0.13bc	10.73±0.49bc	3.70±0.24ab	15.06±0.64bc	129.53±0.38a	362.20±3.88c
M2	91.60±1.75bcd	107.13±0.73ab	3.60±0.07ab	12.26±0.87ab	3.64±0.29ab	16.83±0.23ab	129.33±0.34a	376.62±6.05c
IN1	90.26±0.38cd	104.13±0.57c	3.96±0.26a	14.53±0.84a	3.79±0.33a	17.89±0.34a	124.67±0.38b	501.50±1.31a
IN2	89.67±0.47d	105.40±0.87bc	3.56±0.14ab	14.83±0.28a	3.50±0.14ab	18.00±0.45a	126.53±0.82b	396.42±6.38b
F11,3	11.12	6.98	15.86	12.01	11.51	9.64	15.78	304.13
P	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Five germplasm were used for the study 21213, 21474, 20617, 21260 and 21988. The experiments were conducted to see the effects of chemical fertilizers including Nitrogen and Phosphorus (chemical fertilizer system), farm animal manure (farmyard manure), combination of chemical fertilizer and manure (integrated fertilizer usage) on clay loamy soil of Arid Zone Research Institute (AZRI), Bahawalpur during 2022-2023. Each germplasm containing below combination treatments including negative control (C0) chemical, C2 (15 P+25 N), C1 (30 P+50 N), organic matter; M2 (Cow Dung 10 t/ha) and M1 (Cow Dung 20 t/ha), integrated 1N2 C1 (5 P+10 N+10 Cow dung t/ha) and 1N1 (C1 10 P+20+N+20 Cow dung t/ha) were tested.

Result and Discussion

There were sown five germplasm of *Plantago* to observed eight number of plant parameters accounted for ANOVA and other genetic and phenotypic attributes to check the fertilizers with manure treatments, which shows a significant result among all observation.

Table 2: Plant attributes and other abbreviations.

S. No.	Abbreviation	Name of characters
1	DFI	Days to floral initiation
2	DF	Days to 50% flowering
3	NTPP	Number of tillers per plant
4	NSPP	Number of spikes per plant
5	SL	Spike length
6	PH	Plant height
7	DM	Days to maturity
8	SYPP	Seed yield per plant

The Table 1 represents the findings of Analysis of Variance (ANOVA) for different treatments (C0, C1, C2, M0, M1, M2, IN1 and IN2) for various parameters including (DFI, DF, and Tillers/plant. Spikes/plant, spike length, plant height, Days to maturity and yield). F11,3 and P value shows F and p value for each parameter. The mean value varies for all treatments in DFI. The C0 treatment has the highest mean value (95.998) and IN2 has the lowest mean value (89.66). The F value (11.2) in DFI shows the difference among mean values of various treatments of DFI. The extreme low value of p (0.0000) shows that difference in the mean values of all treatments in DFI is significant In DF50%, C1 has the highest mean value (108.80) and IN1 has the lowest mean value (104.13) and the F value (6.98) shows variations among mean values of DF50%. A low p value (0.0001) shows significant variation between all the treatments. In the number of tillers per plant, the highest mean value is of IN1 (3.9600) and the lowest value (2.2060) is of C0 treatment. The F value is (15.86) and the p-value is (0.0000). It shows the significant variations in number of tillers per plants among various treatments. IN1 has the highest mean value (14.532) in the number of spikes whereas C0 has the lowest mean value (10.400). The F value (12.01) shows that difference in frequency of number of spikes is significant. The p-value (0.0000) also shows significant variations. In the spike length factor, IN1 has the highest mean value (3.7940) and M0 has the lowest value (3.0000). F value in this factor is 11.51 and p-value is 0.0000, which shows the statistical significance. In the Plant height factor, IN1 has the highest mean value (17.898) and C0 has the lowest value (14.000). F value in this factor is 9.64 and p-value is 0.0000, which shows the statistical significance.

Table 3: Correlation analysis between parameters.

	DFI	DF	NTPP	NSPP	SL	PH	DM	SYPP
DFI	1							
DF	0.256929	1						
NTPP	-0.39357	0.158064	1					
NSPP	-0.44954	-0.01091	0.673803	1				
SL	-0.18559	0.216127	0.688008	0.418383	1			
PH	-0.42003	0.008673	0.671631	0.608988	0.44779	1		
DM	0.494058	0.18713	-0.11609	-0.2236	-0.10998	-0.34697	1	
SYPP	-0.41258	-0.04888	0.789972	0.700467	0.590102	0.590269	-0.33703	1

In the days to maturity, the highest mean value is of IN1 (129.53) and the lowest value (125.27) is of C2 treatment. The F value is (15.78) and the p-value is (0.0000). It shows the significant variations in days to maturity among various treatments. The highest mean value for yield is of IN1 (501.50) and the lowest value (295.08) is of C0 treatment. The F value is (304.13) and the p-value is (0.0000). It shows the statistical significance.

Overall, the F values for all the parameters shows significant differences among treatments for all parameters and the p-value indicates the statistical significance for these variations. This shows that the treatments have the significant effects on all the factors.

Correlation analysis

Correlation helps the scientist to know mutual relationships among various variables along with direction and size. Environmental factors also play a role in correlation. Environmental factors and genetic causes of correlation give phenotypic correlation.

DFI (Days to floral initiation) is significant and has positive effect with DM (0.4941) but non-significant and has positive effect with DF (0.2569) whereas DFI is significantly negatively associated with NTPP (-0.3936), NSPP (-0.4495), PH (-0.4200), SYPP (-0.4126) and non-significantly negatively associated with SL (-0.1856). DF (Days to 50% flowering) is non-significant and has positive effect with NTPP, SL, PH and DM while non-significantly negatively associated with NSPP and SYPP. NTPP (Number of tillers per plant) is significant and has a positive effect with NSPP, SL, PH and SYPP. Whereas it is non-significantly negatively associated with DFI (-0.3936) and DM (-0.1161). NSPP (Number of spikes per plant) is significant and has positive

effects with SL, PH, NTPP and SYPP. Whereas it is non-significantly negatively associated with DFI (-0.4495), DF (-0.0109), and DM (-0.2236). SL (Spike length) is non-significant and has negative effect with DFI (-0.1856), DF (0.2161), NTPP (0.6880), DM (-0.1100) and SYPP (0.5901) while it is positively associated with PH (0.4478) and NSPP (0.4184). PH (Plant height) is non-significant and has negative effect with DFI (-0.4200), DF (0.0087), NTPP (0.6716), NSPP (0.6090), SL (0.4478), DM (-0.3470) whereas it is non-significant but positively associated with SYPP (0.5903). DM (Days to maturity) shows non-significant and positive correlation with DFI (0.4941), and DF (0.1871) and it shows non-significant and negative correlation with NTPP (-0.1161), NSPP (-0.2236), SL (-0.1100), PH (-0.3470), and SYPP. SYPP (Seed yield per plant) shows negative correlation with DFI (-0.4126), DF (-0.0489), and DM (-0.3370) and positive correlation with NTPP, NSPP, SL and PH.

Conclusions and Recommendations

The germplasm of isapghol which were used in experiment are not significantly respond to fertilizer among themselves. But fertilizer treatments of different combinations show statistically significant to each other such as day of flower initiation in C0 having greatest mean as compared to IN2 which was lowest mean. In case of day to maturity and yield highest mean observed in IN1 but lowest mean in day to maturity found in C2 and in yield lowest yield mean measured in C0. In dimension of correlation, days to maturity show positive correlation with DFI and DF and negative correlation with NTPP and other parameters. In the case of seed yield per plant show positive correlation with NTPP, NSPP, SL and PH along with negative correlation with DF, DF and DM.

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Novelty Statement

The germplasm of Ispaghol which were used in experiment are not significantly respond to fertilizer among themselves. But fertilizer treatments of different combinations show statistically significant to each other.

Author's Contribution

Malik Muhammad Yousaf: Conceive the idea and overall management.

Abou Bakar Siddique: Did analysis

Zainulabideen: Technical input

M Bilal Zafar: Wrote abstract.

Jahangir shah: Collected data.

Bashir Ahmad: Data entry.

Mumtaz Husain: Wrote methodology.

Maryam Hayat: Data entry on statistix.

Shamsa Rasool: Wrote conclusion.

Usman Majeed: Wrote results and discussion.

Irum Liaqat: Arranged the table.

Mohsin Raza: Introduction.

Muhammad Abrar Yousaf: Took data and field surveys.

Conflict of interest

The authors have declared no conflict of interest.

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