Optimizing Yield and Growth Performance of Ispaghol (*Plantago ovata*) through Evaluation of Different Sowing Techniques

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Abstract- *Plantago ovata* is an important medicinal herb that is also referred to as Isabgol or Ispaghol with pharmaceutical applications, particularly in Iran, Pakistan, and India. This study aimed to assess the performance of Ispaghol's yield and development with different sowing methods. The experiment was conducted at the experimental area of PARC, Arid Zone Research Institute Bahawalpur. Germplasm from five different accessions obtained from IABGR, NARC, Islamabad, Pakistan, was used with three replications and five treatments of a randomized complete block design (RCBD), during the rabi season of 2019-21. Four sowing techniques were employed, including Ridge Sowing (T1), Broadcast Method (T2), Line Sowing or Drill Method (T3), and Flatbed Sowing (T4). Eight genetic parameters, including 50% flowering, floral initiation, Height of plant, Number of tillers per plants, number of spikes per plant, Spike length, days to maturity and plant-specific seed production were noted. to evaluate the impact of sowing techniques on Ispaghol growth. Statistical analysis with genetic variables revealed significant differences across all parameters, suggesting the potential for selecting desired attributes. The results indicated that Line Sowing or Drill Method (T3) and Ridge Sowing (T1) resulted in the highest seed yield per hectare, while the Broadcast Method (T2) showed the lowest seed yield across all five *Plantago ovata* genotypes. T3 (Line Sowing or Drill Method) demonstrated the best growth performance, followed by T1 (Ridge Sowing) and T4 (Flatbed Sowing), while T2 (Broadcast) exhibited the lowest seed yield and overall growth performance. These findings contribute valuable insights into optimizing sowing techniques for Ispaghol cultivation, enhancing seed yield, and promoting its medicinal applications.

Index Terms- Germplasm, Accessions, Pharmaceutical applications, sowing techniques, cultivation

I. INTRODUCTION

Plantago ovata is a plant that is often grown in Iran, Pakistan, and India and is significant in medicine. It is frequently referred to as Isabgol or Ispaghol. Pharmaceutical manufacturers profit from the 20–30% mucilage found in its seeds to treat a variety of conditions, including colon cancer, amoebic dysentery, chronic constipation, gastrointestinal irritation, and high cholesterol (Gupta *et al*., 1994). Indian Muslims brought it as a medicinal plant, and the seeds were first collected from a few wild kinds. It was initially grown in the areas of Lahore and Multan in Pakistan. Ispaghol is the common name for *Plantago ovata* (Family Plantaginaceae). (K. Bahadar and colleagues, 2018). The crust, seed, and entire plant are together referred to as psyllium. Regarded as a beneficial supplier of both soluble and insoluble fibre. Compared to oat bran, it has about eight times the amount of soluble material. The plant's diet fibres have medicinal qualities and can be utilized to make low-calorie foods (Theuissen 2008). *Plantago ovata*, often known as isabgol, is an annual plant that reaches a height of 30 to 40 cm. Isabgol is a native of the Mediterranean area and can be found in Iran, Pakistan, and India's neighbouring regions (Sharma, 2004). The natural and concentrated soluble fibre known as psyllium is derived from golden psyllium seed husks. The husk of Isabgol's principal item. The outermost layer of the seed, known as the husk, is removed mechanically. In total, approximately 25–26% of the seed's husk is retrieved. The expected lifespan of psyllium husk is limited to six months under standard and conventional storage settings (Verma, A., & Mogra, R. (2013). The advantageous dietary qualities of plantago whole grain in comparison to legumes and cereals makes these findings noteworthy (Romero-Baranzini *et al*. 2006). Isabgol produces a hard, difficult-to-break hydrogel that is difficult to disintegrate (Majmudar *et al*. 2002). It was found that the hydrocolloid psyllium seeds was hydrophobic and it was discovered that at various concentrations and pH levels, every solution exhibited unconventional shear dissolution behavior (Farahnaki *et al*. 2010).

Numerous agronomic techniques are available to decrease increase moisture in the soil, reduce erosion of soil, and boost crop production in regions where the water is the main constraint (Belachew and Abera, 2010). Certain activities are associated with distinct techniques of sowing (Ali *et al*., 2020). Numerous studies have been done on various planting techniques, including line cropping, broadcasting, ridges, and raise beds. According to

several of this research, ridge planting produces heavier grains and greatest yields, while broadcasting produces the lowest yields (Bakht *et al*., 2011). Because of enhanced germination, better sowing procedures not just aid keep up an optimal population of plants, but they also allows plants to make use of light, land, and various other resources for input consistently and effectively. Therefore, it is essential to create a planting design that may prevent overcrowding and allow the plants to make better and more efficient use of the resources (Quanqi *et al*., 2008). The Broadcast method, line sowing, ridge with furrow, and broad bed and furrow are among of the most common sowing techniques. The sowing method is also based on the resources of the land, soil conditions, as well as management level. Early emergence & growth are achieved in increased moisture in the soil conditions by disseminating after moderate decking. It is preferable to plant seeds in the moist horizon during line sowing when the moisture regime is regular and preserved (Shekhawat, K., *et al*. 2012). Bakht *et al*. (2011) reported highest yield whilst sowing with ridges while low yield with broadcast method. Herbicides' activities also change depending on how they are sown. Herbicides sprayed to the soil can be easily incorporated into the soil during flat sowing to prevent volatilization losses. Herbicides cannot be incorporated into the soil during ridge sowing (Maqbool *et al*., 2001).

Methodology

The research trial was conducted at the experimental area of PARC, Arid Zone Research Institute, Bahawalpur at the latitude of 29.22º, the longitude of 71.38º and the altitude of 367f. The temperatures of the area varied from 6ºC to 40.7ºC, Rain varied from 6 to 13 mm, and the moisture content was between 76.5 to 80.4%. This research employed germplasm from 5 different accessions (Accession No. 21213, 21474, 20617, 21260 and 21988) collected in the 2019–20 rabi season via IABGR NARC, Islamabad Pakistan & put in the RCBD comprising three replicates. Four distinct sowing techniques were employed to evaluate their impact on Ispaghol growth and yield. The sowing techniques used were (T1 (Ridge Sowing): Seeds were sown in ridges, T2 (Broadcast Method): Seeds were spread uniformly over the field, T3 (Line Sowing or Drill Method): Seeds were sown in neat rows using a drill, T4 (Flatbed Sowing): Seeds were sown on flatbeds without forming ridges or rows.) Eight factors were included in this data collection. These parameters included 50% flowering, floral initiation (DFI), Plant height, Tillers per plants (NTPP), Spikes per plants, Spike length (SL), Days to maturity and seed yield.

Plant stand: The number of healthy plants per square meter.

Days to flower initiation: The duration from sowing to the appearance of the first flower.

Days to 50% flowering: The time it took for half of the plants to start flowering.

Number of plants/m²: The plant density per square meter.

Plant height (cm): The vertical length of the plants.

Number of tillers/plants: The secondary stems or branches emerging from each plant.

Number of spikes/plants: The count of flowering spikes on individual plants.

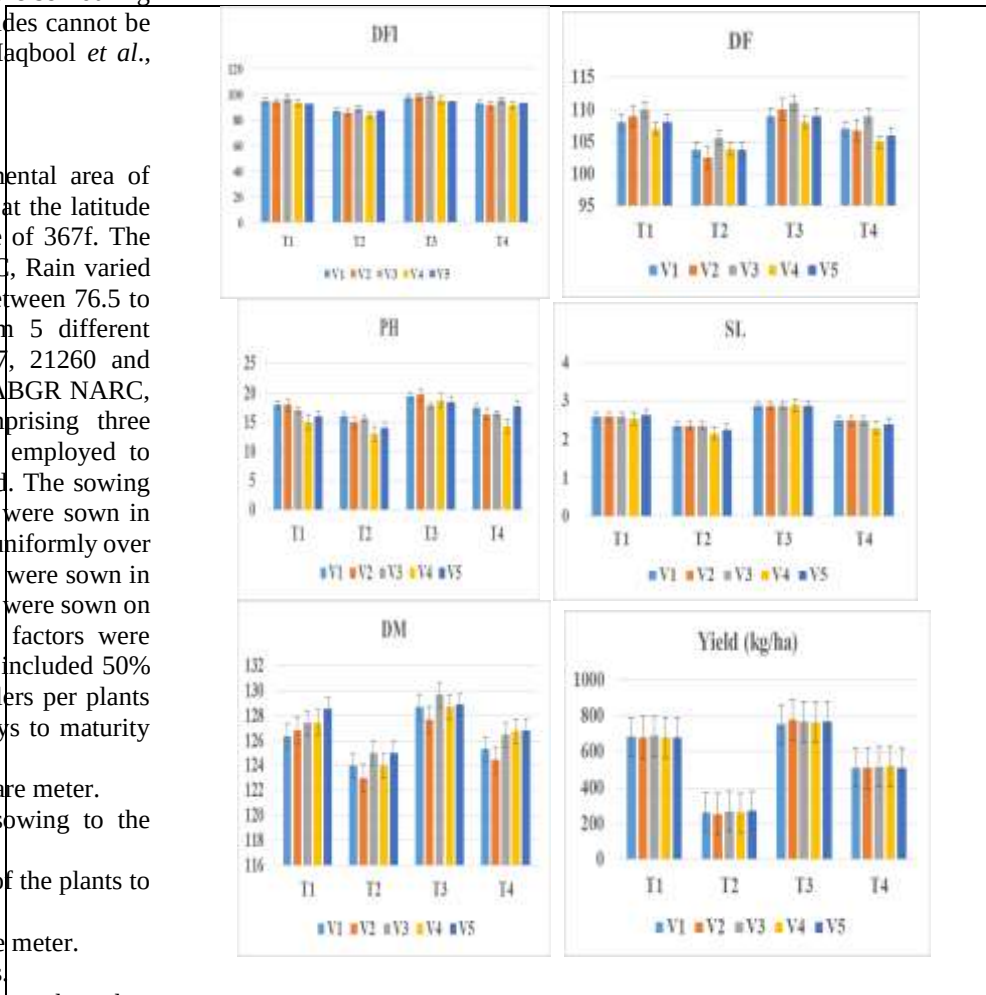
Spike length (cm): The measurement of the length of the flowering spike.

Days to maturity: The time it took for the crop to reach full maturity.

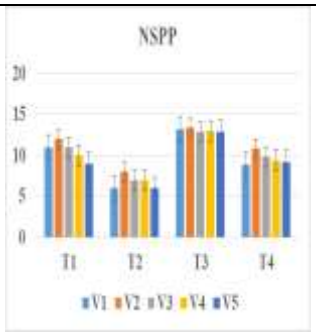
Seed yield (kg/ha): The total seed output per hectare of land.

Results and Discussion

The statistical analysis helped determine if there were statistically significant differences in the growth and yield parameters among various sowing methods. The result indicated that (T3) line sowing (Drill) Method and T1: ridge sowing, produced the maximum seed yield per hectare whereas the lowest seed yield was observed in T2 (Broadcast) for all the five accessions of Ispaghol germplasm which includes (Accession No. 21213, 21474, 20617, 21260 and 21988). All the parameters showed better growth performance with T3 (Line Sowing or Drill Method) followed by T1 ((Ridge Sowing), T4 (Flatbed Sowing). The lowest seed yield and growth performance of all the parameters was observed in T2 (Broadcast) method.



Sr No.	Abbreviations used	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



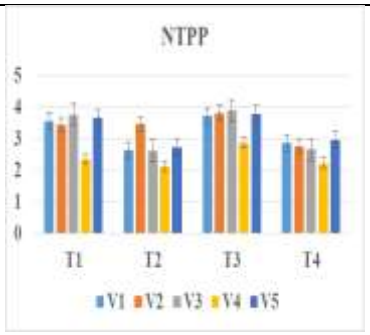


Table 1. Various parameters of Ispaghol (*Plantago ovata*) under different sowing techniques.

Table 2: Plant attributes and other abbreviations.

Correlation analysis

Correlation analysis began with the goal of understanding how different attributes interact and contribute to yield. This association was observed for eight different factors.

	DFI	*DF*	*NTPP*	*NSPP*	*SL*
DFI	1				
DF	0.936678	1			
NTPP	0.612209	0.646215	1		
NSPP	0.865251	0.846026	0.624493	1	
SL	0.840065	0.836365	0.728506	0.901629	1
PH	0.805225	0.756687	0.705194	0.814367	0.865618
DM	0.849369	0.816414	0.534622	0.770633	0.822753
SYPP	0.913409	0.889386	0.616347	0.920817	0.890551

Table 3. Correlation analysis between various parameters

DFI has a significant positive correlation with (DM) of 0.849 and (SYPP) of 0.913. DFI shows a moderately positive correlation with DF, NTPP, NSPP, Spike Length (SL), and Plant Height (PH) (0.612 to 0.840). Days to 50% Flowering (DF) has significant positive relationships with DFI (0.937), DM (0.816), and SYPP (0.889), and moderate positive correlations with NTPP, NSPP, SL, and PH (0.646 to 0.836). Number of Tillers per Plant (NTPP) indicates substantial positive correlations with DF, DFI, NSPP, SL, PH, and DM (ranging from 0.535 to 0.729), but only a slight positive correlation with SYPP (0.616). NSPP has a significant positive correlation with SL and SYPP (0.902 and 0.921, respectively). It has moderate positive correlations with DF, DFI, NTPP, PH, and DM (0.624–0.771). Spike Length (SL) displays significant positive associations with NSPP and SYPP (0.902 and 0.891 respectively) and moderately positive correlations with DF, DFI, NTPP, PH, and DM (0.728 to 0.901). Plant Height (PH) has moderate positive relationships with DF, DFI, NTPP, NSPP, SL, and DM (0.705–0.866). It shows a moderately positive correlation with SYPP (0.760). Days to maturity (DM) had moderate positive relationships with DFI, NTPP, NSPP, SL, PH, and DF (range from 0.534 to 0.849), and a significant positive correlation with SYPP (0.896). Seed yield per plant (SYPP) has a significant positive correlation with NSPP and SL (0.921 and 0.891, respectively). It demonstrates slight positive correlations with DFI, DF, NTPP, PH, and DM (0.616–0.913). These correlation values offer insight on the interactions between parameters. Strong positive correlations indicate that when the value of one factor increases, so does the other, whereas strong negative correlations suggest the opposite.

Conclusion

This study aimed to evaluate the best sowing technique for better growth and Yield performance of Ispaghol (*Plantago ovata*). The eight different parameter of five plantago genotypes (Accession No. 21213, 21474, 20617, 21260 and 21988) were studied under four sowing methods which includes (Line Sowing or Drill Method, Ridge Sowing, Flatbed Sowing and Broadcast method). The statistical analysis was performed after collecting the relevant data for all the parameters. The analysis concludes that Ispaghol (*Plantago ovata*) showed better growth in terms of all the phenotypic traits and overall yield, when sown via Line Sowing or Drill Method followed by Ridge Sowing and Flatbed Sowing. The

lowest seed yield and growth performance of all the parameters was observed in the Broadcast method. In terms of correlation the results shows that seed yield per plant (SYPP) has a significant positive correlation with NSPP and SL (0.921 and 0.891, respectively).

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