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Research Article

Comparison of Exotic Ispaghol (*Plantago ovata* Forsk.) Genotypes with the Local Variety 'Gulabi'

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ABSTRACT

Sindh is the main hub of Ispaghol cultivation due to its favorable climate for its expansion. However, limited information is available on the morphology and genetic variability of Ispaghol, particularly with respect to its exotic genotypes. Focusing these outlines, two-year study was conducted during 2023-24 and 2024-25 at Tobacco and Medicinal Crop Research Institute, Tandojam (Sindh) Pakistan. Under this study, it was tried to screen out the adoption of high-yielding exotic varieties for improving Ispaghol yield in Sindh. Results of present study indicated that there was a great variability for morphological, physiological, yield parameters in exotic Ispaghol genotypes as compared to well adopted local variety *Gulabi* under Tandojam conditions for both studied years (2023-24 and 2024-25). Seed index, was ranged between 1.8 to 2.2g with average mean 2.0 g among exotic genotypes. The lowest 1000 (thousands) seeds weight was recorded in *Gulabi* (1.3 to 1.6 g). According to the findings four genotypes promising better seed yield kg ha^{-1} (from 874 to 1148kg ha^{-1}) with the husk yield (225.7 to 330.9 kg ha^{-1}) while as compared to local *Gulabi* with lower seed yield (679 kg ha^{-1}) with husk yield (160 kg ha^{-1}). The main conclusion arising from this study is that on the basis of seed yield per plant IELF-1, IELF-2, IELF-3 and IELF-4, can be chosen for commercial cultivation in Tandojam conditions over to local *Gulabi*.

Keywords: Ispaghol; Exotic genotypes; Growth; Yield.

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INTRODUCTION

Ispaghol (*Plantago ovata* Forsk), has been in medicine since ancient times, but it has only been cultivated as a medicinal plant in recent decades (Tyagi et al., 2016). It is known for its superior quality husk which is preferred over others by helping to reduce risk of heart attack by decreasing serum cholesterol through proper excretion of bile acids. Clinical evidence confirms that Ispaghol moderates postprandial glucose levels, supporting diabetes management, while its high fiber content enhances satiety and aids in weight control (Jat et al., 2015; Aleixandre etl al., 2016; Kirti & Arya, 2019). It has hypoglycemic, anti-cancerous, antitoxic, hypotensive cardiac depressant, hypo chloresteremic and cholinergic activities. In addition to these medicinal uses, it is also utilized in ice-cream/food industry, dyeing/ calico-printing as stabilizer (Shah et al., 2020). The leftover mater is used for birds/poultry and cattle feed.

According to Amanullah et al. (2016) area under its cultivation (estimated under 6,000 acres) and production (only 600-800 kg ha^{-1}) in Pakistan is very small compared to India (up to 1.5-2 t ha^{-1}) (Bukar et al., 2016; Sher & Khatoo, 2018; Sikandar et al., 2020). This limited area under Ispaghol in Pakistan is because crop grows in specific soils and climates (it needs cool, dry winters and light sandy soils).

Improving Ispaghol yield requires strategies: adoption of improved varieties for high-yielding (Bafra et al., 2011) and improved agronomic practices (Kang, 1993; Pervez et al., 2010). Continuous use of a narrow range of local varieties often leads to genetic uniformity, yield stagnation, and increased vulnerability to biotic and abiotic stresses (Mahender et al., 2017). Introducing exotic varieties and species is a key strategy in modern agriculture to enhance climate resilience, increase profitability, and diversify food supplies (Rehana et al., 2012; Ahirwar et al., 2015; Anwar & Rabia 2017). These non-indigenous plants not traditionally grown in a specific region-are often chosen for their superior genetic potential for high yield and adaptability (Shivran, 2016). Exotic genotypes, developed or conserved under different agro-ecological and climatic conditions, may possess superior traits such as higher yield potential, early or synchronized maturity, improved quality traits, and tolerance to stresses like drought, heat, salinity, or major pests and diseases (Zhang et al., 2019). To meet the increasing demand for consumption and industrial processing, recent advancements in crop production have emphasized the introduction and evaluation of exotic genotypes to improve productivity, quality, and adaptability under local agro-ecological conditions. Keeping this in view, an experiment was conducted to evaluate suitable genotypes and management practices to meet the production requirements of Sindh under local agro-ecological conditions.

MATERIALS AND METHODS

A two-year field study was organized during 2023-24 and 2024-25 at Tobacco and Medicinal Crop Research Institute, Tandojam (Sindh) Pakistan to find out the high-yielding exotic variety for improving Ispaghol quality and yield as compared to local growing variety. The experimental site is about 162 km away from Karachi and located at 25.43° N, 68.53° E with elevation of 22m (72 ft) above sea level, the climate of site is arid tropical marine. The mean monthly summer rainfall is 75 mm and winter rainfall less than 5 mm with summer mean daily temperature 34 °C - 40 °C and between 19 °C - 20 °C in winter. Soil of Indus Delta is Silty-clay Loam with calcareous in nature. The experiment was laid out in Randomized Complete Block Design (RCBD), replicated thrice with a plot size of 3 m × 4 m. Seed of four exotic genotypes: IELF-1, IELF-2, IELF-3, IELF-4 (received from Ayub Agricultural Research Institute, Faisalabad) and Local Check (*Gulabi*) were sown on 15th November, with 2-2.5 kg acre^{-1} seed rate through drilling in 9 cm row length at 30 cm spacing apart rows and while plant-to-plant spacing was maintained at 10 cm by thinning after emergence. Fertilizers were applied at the rate of 40 kg N, 20 kg P_2O_5, and 20 kg K_2O ha^{-1}. The full dose of phosphorus and potassium and half of nitrogen were applied at sowing, while the remaining nitrogen was top-dressed at the early vegetative stage. Three irrigations at 20, 50 and 80 days after sowing and three weeding at 15, 40 and 80 days after sowing were conducted. Weeds were controlled by one hand weeding at 25–30 days after sowing. No serious pest or disease incidence was observed during the crop season; however, the crop was regularly monitored. When required, recommended cultural and mechanical practices were adopted to keep the crop free from pests and diseases. The crop was harvested in the month of March; five fully mature plants were randomly selected from each genotype in every replication of each treatment for recording data on different agronomic parameters. Meteorological data was collected from National Meteorological Observatory station Tandojam and presented in the Figure 1. Soil samples were also collected. The results are reported as the mean ± standard deviation (SD). Analysis of variance (ANOVA) was employed to measure significant differences between and within genotype with SPSS 18.0 (SPSS Inc., Chicago, IL, USA). The mean comparison was conducted using Duncan's multiple range test the least significant difference (LSD) test at a 5% probability level will be used for comparing the mean of each testing genotype (Gomez & Gomez, 1984).

RESULTS

Ispaghol is commercially an important crop with different uses. However, limited information is available on the morphology and genetic variability of Ispaghol, particularly with respect to its exotic genotypes. Under this study, it was tried to screen out the adoption of high-yielding exotic varieties for improving Ispaghol as compared to local variety. Results of present study indicated that there was a great variability for morphological, physiological, yield parameters in exotic Ispaghol genotypes as compared to well adopted local variety *Gulabi* (Table 2 and 3) for both studied years (2023-24 and 2024-25). The mean performance of these exotic genotypes and local check for all the morphological and yield attributing characters are presented in subsequent tables (Tables 2 and 3, Figures 2), showed significant variation among the different genotypes for different parameters.

Physical characteristics of Soil

To check soil physico-chemical properties like pH, EC (dS m^{-1}), organic matter (%), total N (%), available P (mg kg^{-1}), and extractable K (mg kg^{-1}) soil samples were collected from experimental site during both studied years (Table 1).

Table 1. Physical characteristics of soil.

Years	Location	Depth (cm)	Texture	pH	EC (dS m^{-1})	OM (%)	Total N (%)	P (mg kg^{-1})	K (mg kg^{-1})
2023-24	Tobacco and Medicinal Crop Research Institute, Tandojam	0-18	Silty Clay Loam (Medium)	8.3	0.73	0.82	0.039	7.45	126.35
2024-25				8.1	0.65	0.96	0.047	9.56	114.57

Note: EC=electrical conductivity (us m^{-1}), OM=Organic matter (g kg^{-1}), N=Nitrogen (%), P=phosphorus (mg kg^{-1}), K=potassium (mg kg^{-1}).

Weather variables

The atmospheric conditions influence crop growth, soil processes, and overall ecosystem functioning. The most important variables include temperature (^{0}C), rainfall (mm), relative humidity (%), and day length (h.m). Temperature regulates plant metabolic activities, while rainfall is the primary source of soil moisture and determines water availability for crops. Relative humidity influences evapotranspiration and pest or disease incidence, whereas day length directly affects photosynthesis and plant development. Together, these weather variables provide a comprehensive understanding of the climatic conditions of a region, which is essential for agricultural planning, crop selection, and management practices (Omidbaigi & Mohebby, 2012; Nimisha & Anil, 2022). According to the data of both growing seasons (Figure 1), the mean maximum temperature ranged between 23–34°C, while the mean minimum temperature varied from 7–16°C. The total rainfall received during the season was 1.5 mm. Relative humidity remained moderate, averaging 63%, which created favorable conditions for crop growth. The average sunshine duration was about 10.5 hours per day**,** ensuring adequate solar radiation for photosynthesis. Overall, the prevailing weather conditions were favorable for crop establishment and growth, with suitable ranges for field Ispaghol production.

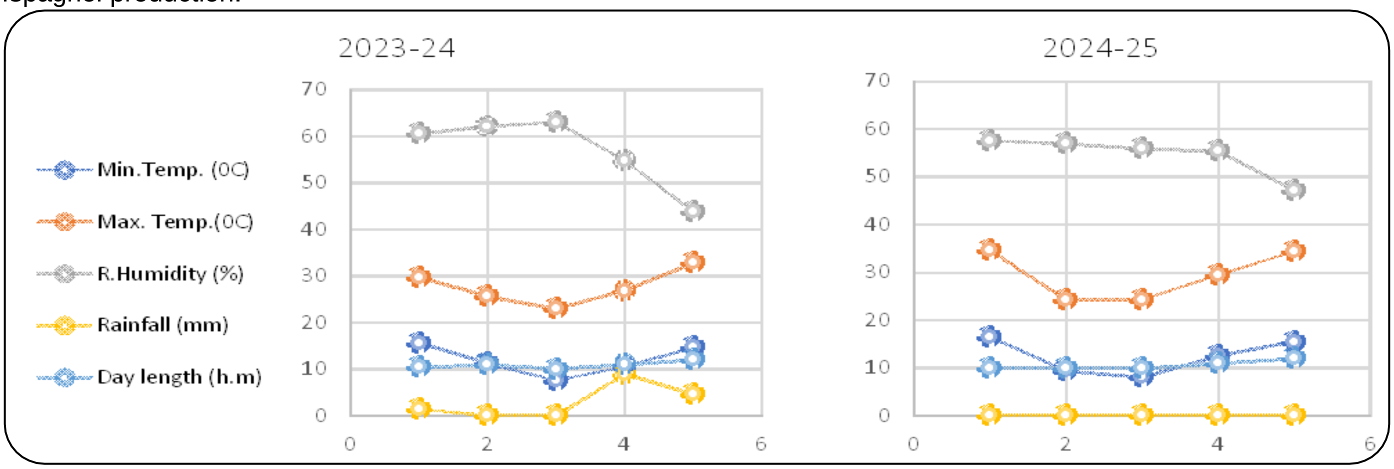

Figure 1. Weather variables of both growing seasons

Morphological Parameters

Height of plants was ranged from ± 28 to 32 cm with average mean value of ± 30 cm for both years. The Coefficient of variation of exotic genotypes for plant height was 10.74% and 9.68% in 2023-24 and 2024-25 respectively (Table 2). The data revealed that amongst four genotypes under study, the tallest plant (~32.04 cm) was IELF-1 and the shortest was IELF-3 with ~28.71 cm plant height as compared to *Gulabi* (~30.80 cm) during both studied years (Table 3). This variation might be due to genetic constituents of genotypes, healthy root development and agro-climatic conditions. Besides these, the greater availability of nutrients in soil due to integrated fertilizer application through inorganic and organic sources might possibly have enhanced meristematic activity leading to increased plant height and dry matter accumulation (Table 2). The maximum number of tillers plant^{-1} was exhibited in the genotype IELF-4 (~7.8) followed by IELF-3 (~7.4) while as minimum value for tillers plant was observed in the Local Gulabi (~4.1) during 2023-24 and 2024-25 (Table 3). The mean performances between various genotypes of Ispaghol for number of tillers plant^{-1} was ~6.35 with range 4.5 to 7.8 during both years (Table 2). These findings were also supported by (Hendry et al., 1992). The C. Variation for exotic genotypes for tillers plant^{-1} was 19.06% and 24.52% respectively in 2023-24 and 2024-25. Local Check *Gulabi* has less numbers of tillers (~4.1) as compared to exotic genotypes (Table 3). The exotic genotype IELF-1 got more days (~120) to be matured as compared the remaining exotic genotypes, while as *Gulabi* was late maturity (~135 days) variety over all tested material during studied years. Among four exotic genotypes, IELF-4 showed earliness (~96 days) to maturity during both years (Table 3). Such type of variation between various genotypes in Ispaghol for days taken to maturity have also been reported by (Dubey et al., 2009). This might be due to individual varietal characters. Matureness of tested genotypes was ranged from 96 to 120 days with average mean value of 108 for both years. The Coefficient of variation exotic genotypes for crop maturity was 10.5% for both years (Table 2).

Table 2. Mean + SE of morphological and yield characters of four exotic genotypes of Ispaghol and local check Gulabi.

Attributes	Exotic Genotypes				Local variety			
2023-2024	Mean	Range	CV%	anova	Mean	Range	CV%	anova
Plant height (cm)	30.32 ± 3.15	28.6-32.0	10.74	*	28.95 + 0.12	26.8-31.01	0.40	*
Tillers plant^{-1}	6.35 ± 1.21	4.9-7.7	19.06	**	3.61 ± 2.01	3.1-4.1	48.91	**
Days to maturity	108 ± 11.34	97-120	10.50	**	133.50 ± 12.75	131-135	9.55	**
Spike length (cm)	3.97 ± 0.99	2.7-5.14	24.32	NS	2.12 ± 0.87	1.7-2.7	41.04	NS
Spikes plant^{-1}	24.07 ± 5.70	17.9-30.7	24.71	NS	10.15 ± 6.11	9.4-10.7	60.20	NS
Seeds spike^{-1}	89.60 ± 4.10	85.1-93.9	4.58	**	69.81± 5.32	68.8-70.8	7.62	**
Seed Index (g)	1.99 ± 0.12	1.8-2.1	6.03	***	1.32 ± 0.18	1.2-1.5	27.42	***
Seed Yield plant^{-1}	4.9 ± 0.49	4.1-5.1	10.00	***	3.55 + 0.87	3.2-3.9	24.03	***
Seed Yield (Kg ha^{-1})	1010.63 ± 112.6	880.8-1139.2	11.38	***	679.23 ± 113.34	676.3-682.1	16.67	***
Husk Yield (Kg ha^{-1})	278.1 ± 56.1	225.7-330.9	20.25	**	163.64 ± 57.11	158.3-168.3	34.90	**
2024-2025								
Plant height (cm)	31.1 ± 2.88	29.7-32.5	9.68	*	29.21 ± 3.21	26.9-31.5	10.99	*
Tillers plant^{-1}	6.20 ± 1.52	4.5-7.8	24.52	**	3.92 ± 1.45	3.21-4.7	36.99	**
Days to maturity	108 ± 11.34	96-121	10.50	**	134.68 ± 10.23	133-136	7.71	**
Spike length(cm)	3.97 ± 0.87	2.8-5.16	21.38	NS	2.25 ± 0.99	1.7-2.8	90.83	NS
Spikes plant^{-1}	24.06 ± 5.63	17.9-30.6	24.36	NS	10.28 ± 6.27	10.0-10.3	60.99	NS
Seeds spike^{-1}	89.93 ± 4.55	84.8-94.9	5.06	**	69.9 ± 4.18	68.9-70.9	5.74	**
Seed Index (g)	2.05 ± 0.17	1.8-2.2	8.72	***	1.64 + 0.34	1.4-1.8	15.00	***
Seed Yield plant^{-1}	4.96 ± 0.24	4.6-5.1	4.84	***	3.55 ± 1.31	3.2-3.8	40.31	***
Seed Yield (Kg ha^{-1})	1011.38 ± 115.5	874.6-1148.1	11.68	***	679.45 ± 102.82	677.5-682.7	15.13	***
Husk Yield (Kg ha^{-1})	278.91 ± 56.07	225.7-331.3	20.23	**	163.9 ± 62.11	158.2-168.8	37.91	**

Exotic genotype IELF-4 produced longest spike length (~5.16 cm) and showed stability for this morphological trait as compared to remaining genotypes and *Gulabi* (1.75 cm) during studied years (Table 3). Range for spike length was from 2.7 to 5.16 cm with average mean value of 3.97 cm for both years. The Coefficient of variation of exotic genotypes for spike length was 24.32% during 2023-24 and 21.38% during 2024-25 (Table 2). Similar results in case of spike length was reported by (Dubey et al., 2009). During the study, the range for spikes plant^{-1} from 17.9 to 30.7 with average mean value of ~ 24.06 for both years. The Coefficient of variation of exotic genotypes for spikes plant^{-1} was ~24.71% during 2023-24 and 2024-25 (Table 2). The maximum number of spikes plant^{-1} (~30.7) was recorded for IELF-3 genotype followed by IELF-4 (25.9), while the minimum number of spikes plant^{-1} was observed in *Gulabi* (~10.6) during both years (Table 3). Similar findings have also been observed by (Sharma & Garg, 2002; Sharma, 2004; Sharma et al., 2013). The improvements in yield attribute characters with balanced nutrient application are in close conformity with Singh & Lal (2009), Mann & Vyas (1999).

Yield Parameters

Seeds spikes^{-1} was ranged from ± 85.1 to ± 93.9 with average mean value of ± 89.60 for both years. The Coefficient of variation of exotic genotypes for seeds spikes^{-1} was 4.58% and 5.06% in 2023-24 and during 2024-25 respectively (Table 2). The mean performances between various genotypes in Ispaghol for seeds spikes^{-1} has also been reported by (Dubey et al., 2009). In the case of *Gulabi*, it was ranged between from 68.8 to 70.8 in 2023-24 and from 66.9 to 70.9 in 2024-25 with average mean of 69.81 during 2023-24 and 2024-25 respectively. As shown in Figure 2, the maximum number of seeds spikes^{-1} was found in exotic genotypes as compared to *Gulabi* during both growing seasons.

Table 3. Comparison of four exotic genotypes of Ispaghol with local check Gulabi for quantitative parameters.

2023-24	Plant height (cm)	Tillers plant^{-1}	Days to Maturity	Spike Length (cm)	Spikes plant^{-1}
IELF-1	32.04 ± 6.05	5.8 ± 0.87	120 ± 22.75	2.85 ± 1.34	17.9 ± 4.75
IELF-2	30.61± 4.10	4.9 ± 0.49	115 ± 31.32	3.32 ± 0.74	19.7 ± 2.25
IELF-3	28.71± 6.30	7.4± 1.75	100 ± 28.17	4.98 ± 2.12	30.7 ± 6.14
IELF-4	31.65 ± 10.75	7.7 ± 2.52	97 ± 18.05	5.17 ± 2.75	25.9± 3.02
Gulabi	30.80± 09.12	4.1± 0.35	135 ± 35.77	1.77 ± 1.08	10.4 ± 3.00
2024-25					
IELF-1	32.05± 12.08	5.4 ± 2.11	121 ± 57.11	2.88 ± 1.45	17.9 ± 5.00
IELF-2	30.01 ± 10.88	4.5± 3.01	115 ± 60.23	3.87 ± 1.03	19.3 ± 2.08
IELF-3	28.73 ± 9.32	7.1 ± 1.12	101 ± 52.18	4.94 ± 2.06	30.6 ± 5.02
IELF-4	31.51 ± 7.13	7.8 ± 2.20	96 ± 32.03	5.16 ± 0.88	25.9 ± 3.11
Gulabi	30.81 ± 8.52	4.0± 3.00	136 ± 61.34	1.75 ± 1.25	10.7 ± 2.88

The highest total seed yield (~1011.38 kg ha^{-1}) weighted from exotic genotype while the lowest yield was recorded by *Gulabi* (~679 kg ha^{-1}) during both years. Similar findings have also been observed by Sangan et al. (1992). These outcomes are in occurrence with the Soomro (2004) had also found greater seed yield which were very close to these results. Range for seed yield was from 880.6 to 1139.2 kg ha^{-1} with 11.38% and from 874.6 to 1148.1 kg ha^{-1} with 11.68% Coefficient of variation respectively in 2023-24 and during 2024-25 (Tables 2, Figure 2). The husk yield has recorded significantly maximum (±225.7 to 330.9 kg ha^{-1}) in four exotic genotypes with mean value of 278 kg ha^{-1} while as the lower husk yield range (158 to 168 kg ha^{-1}) was recorded from local *Gulabi*. The maximum husk yield might be due to higher plant population per unit area and adequate supply of organic and inorganic fertilizer and FYM to plants in balanced proportion increased seed and husk yield. The Coefficient of variation of exotic genotypes for husk yield kg ha^{-1} was 20% for 2023-24 and 2024-25 years (Tables 2, Figure 2). These results are in accordance with the findings of Jadhav et al. (2008) and Barfa et al. (2011) that the increased seed and husk yield might be due to better nutritional status of the crop in the soil as evidenced by their uptake in the plant. Husk recovery, as revealed from ANOVA suggesting the existence of high genetic variability among different genotypes for the trait studied. Almost similar findings were also reported by Singh & Lal (2009), Jain & Paul (2011) and Yousaf et al. (2022) for most of the traits The optimal supply of organic and inorganic fertilizer with good management, may have accelerated various physiological processes in the plant, resulting in increased growth and yield parameters, as well as increased seed and husk yield. The differences in number of spikes per plant, number of seeds per spike and seed index in different genotype might be due to variation in germplasm, proper vegetative development and also for differences in soil and agro-climatic condition. Thousand seed weight (seed index), which is very important yield component, showed variation among the genotypes. It was ranged between ~1.8 g to 2.2g with average mean ±2.0 g in both years among exotic genotypes (Table 2, Figure 2). The lowest 1000 (thousands) seeds weight was recorded in *Gulabi* (~1.3 to 1.6 g) during both studied years. The Coefficient of variation of exotic genotypes for seed index was 8.7% and 6.03% in 2023-24 and 2024-25 respectively (Table 2). According to the findings presented in Table 2, four genotypes promising better seed yield plant^{-1} ranging from ~4.6 to 5.1 g plant^{-1} with average mean value of 4.9 g for both years as compared to Local *Gulabi* which produced minimum mean ~3.5 g yield plant^{-1} during both years with ranging from 3.2 to 3.8 g yield plant^{-1}.

The Coefficient of variation of exotic genotypes for seed yield plant^{-1} was 10 % and 4.84% in 2023-24 and during 2024-25 respectively (Table 2). The higher yield of promising genotypes might be due to higher number of branches, which leads to the production of a greater number of spikes per plant that directly affect the production of higher seed yield. The seed yield data also supported by Beniwal et al., (2007); Jadhav et al., (2008) and Barfa et al., (2011).

Growth Parameters

Among the growth parameters (Table 4), each parameter was observed significant in response to the genetic variation. Each parameter was observed lower in check variety as compared to rest of the exotic genotypes. Leaf Area Index (LAI) is a key indicator of canopy development and represents the ratio of total leaf area to ground area. A higher LAI indicates greater photosynthetic surface, which enhances light interception and biomass accumulation, provided that it does not lead to excessive shading. The leaf area index (LAI) of the varieties increased progressively from 2.03 to 2.49 in IELF-2 and IELF-3 respectively during both years as compared to Gulabi (1.84). Crop Growth Rate (CGR), expressed as grams per square meter per day (g m^{-2} day^{-1}), reflects the efficiency of the crop in producing dry matter over time. Higher CGR values ~4.44 and 4.41 (g m^{-2} day^{-1}) was observed from genotypes IELF-3 and IELF-4 respectively during both years that indicate vigorous crop growth and efficient resource utilization (Table 4). According to Soomro (2004) the crop growth rate (CGR) showed a steady rise during the vegetative phase, indicates vigorous biomass accumulation during this period. Net Assimilation Rate (NAR), also expressed in g m^{-2} day^{-1}, measures the rate of dry matter production per unit leaf area, essentially showing the photosynthetic efficiency of individual leaves. The highest (7.11 g m^{-2} day^{-1}) net assimilation rate (NAR) was recorded in IELF-4 genotypes during the early growth stages when individual leaves were more efficient in photosynthesis, but declined to 4.33 g m^{-2} day^{-1} in *Gulabi* due to canopy shading and aging leaves (Table 4). According to Amanullah et al. (2016) for better crop growth, an optimum balance among these parameters is required: LAI should be high enough to maximize light interception, CGR should steadily increase during the vegetative phase, and NAR should remain sufficiently high to ensure efficient biomass production per unit leaf area. Together, these indices provide a comprehensive understanding of crop performance and help in evaluating management practices that improve yield potential. The combined trend of increasing LAI, high CGR, and sustained NAR during the mid-growth stage contributed to better crop growth and dry matter production, ultimately supporting higher yield potential.

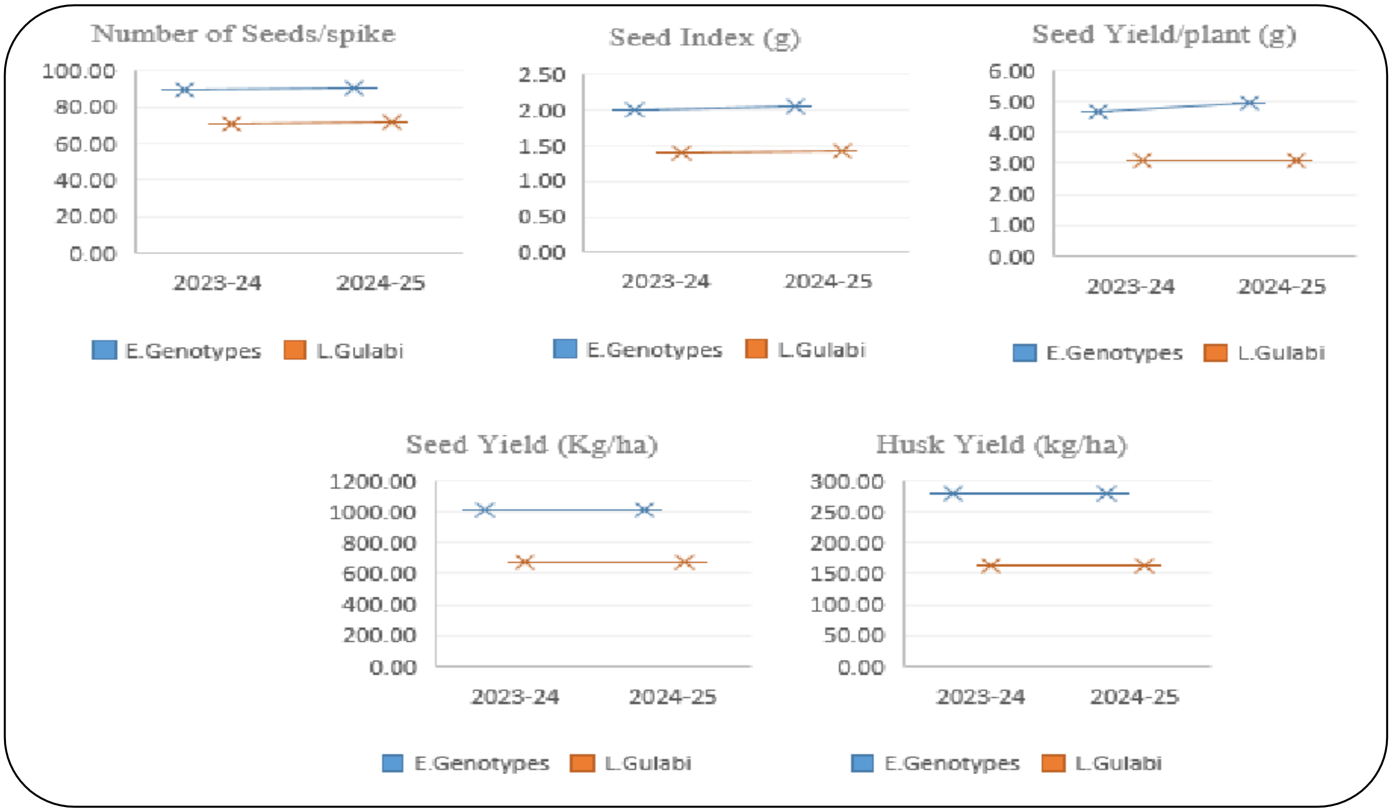

Figure 2. Comparison of four exotic genotypes of Ispaghol with local check Gulabi for qualitative parameters.

Table 4. Growth parameters of four exotic genotypes of Ispaghol and local check Gulabi.

	2023-24			2024-25		
E. Genotypes & L. Check	LAI	CGR ($g\ m^{-2}\ day^{-1}$)	NAR ($NAR\ g\ m^{-2}\ day^{-1}$)	LAI	CGR ($g\ m^{-2}\ day^{-1}$)	NAR ($NAR\ g\ m^{-2}\ day^{-1}$)
IELF-1	2.29	4.25	6.20	2.27	4.20	6.19
IELF-2	2.07	4.26	5.38	2.03	4.25	5.39
IELF-3	2.45	4.44	6.48	2.49	4.43	6.48
IELF-4	2.13	4.41	7.10	2.17	4.40	7.11
(Gulabi)	1.84	3.14	4.34	1.84	3.17	4.33

Note: LAI= Leaf area index, CGR= Crop growth rate (g m-2 day-1), NAR= Net Assimilation Rate (NAR g m-2 day-1).

CONCLUSION

The number of spikes per plant, number of seeds per spike, seed index, seed yield (kg ha^{-1}), yield per plant, and husk yield (kg ha^{-1}) are important yield components that exhibited considerable variation among the different exotic genotypes compared with the local cultivar Gulabi. The observed differences in these yield traits may be attributed to genetic variability in the germplasm, differences in vegetative growth, and variations in soil and agro-climatic conditions**.** Seed index, was ranged between 1.8 to 2.2g with average mean 2.0 g among exotic genotypes. The lowest 1000 (thousands) seeds weight was recorded in *Gulabi* (1.3 to 1.6 g). According to the findings four genotypes promising better seed yield kg ha^{-1} (from 874 to 1148kg ha^{-1}) with the husk yield (225.7 to 330.9 kg ha^{-1}) while as compared to local *Gulabi* with lower seed yield (679 kg ha^{-1}) with husk yield (160 kg ha^{-1}). The main conclusion arising from this study is that the on the basis of seed yield per plant IELF-1, IELF-2, IELF-3 and IELF-4, can be chosen for commercial cultivation in Tandojam conditions over to local *Gulabi*.

AUTHOR CONTRIBUTIONS

Add authors' contributions.

COMPETING OF INTEREST

The authors declare no competing interests.

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