# Morphophysiological analysis of growth and yield of Isabgol *(plantagoovata*Forsk) as influenced by fertilizer levels

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Abstract: An experiment was laid out in a factorial randomized block design (FRBD) with four replications. In this experiment three varieties ($V_1$ : GI-1, $V_2$ : HI-5 and $V_3$ : Niharika) with two fertilizer levels ( $L_1$ :50:25:00, $L_2$ : 100: 50: 00 NPK kg/ha) were used. The observations on different morphological characters viz., Growth studies, dry matter studies, days required for different growth stages, yield attributes and yield along with the nutrient uptake was recorded. The studies revealed that among the three genotypes, variety Niharika responded well to fertilizer level resulting in significant increase in growth, yield contributing characters and yield of the crop. Further it was found that application of fertilizer dose of 100:25 NP kg/ha recorded numerically higher values for growth, yield and quality characters and it was statistically found at par with 50:25 NP kg/ha fertilizer dose. Therefore, the application of 50:25 NP kg/ha dose to Niharika genotype would result to achieve higher Isabgol yield rather than 100:25 NP kg/ha dose.

Keywords: Isabgol, *PlantagoovataForsk,* NPK, growth parameter.

## 1. Introduction

Isabgol *(PlantagoovataForsk 2 n = 2x = 8)* commercially known as bland *Psyllium* is one of the most important medicinal plant with commercial value. It belong to *'Plantaginaceae'* family, this family consist of three genera viz. Bourgueria (Decne), *Littarella* (Bergivs) and *Plantago*(L) and about 200 species which are either annual or perennial herb. It is herbaceous plant generally known as autumn sown annual. Plant height ranging from 40-45 cm and highly cross – pollinated crop and important part is husk and seed.

Among species belonging to genus *Plantago* only two species *P.ovata F.*( blandpsyllium or Isabgol) and *P.psyllium*linn. (French psyllium) are economically important. *Plantagoovata* F is small annual plant of warm temperature; sandy region (located between $26^0$30' N latitude and distributed from canary islands, across southern Spain, North Africa, Middle East Pakistan, North Western India and Southern part of Soviet Central Asia (Stebbins and Day, 1967)

Important part of Isabgol is mucilage which is polysaccharide coating on seed. The separated husk is popularly known as 'Sat Isabgol' in Indian market. It is used as medicine for intestinal and stomach disorder. It absorbs moisture and form tasteless mucilaginous jelly. Jelly induces intestinal peristalsis for easy ejection and therefore useful in constipation. Refined husk is used in food industry, for manufacturing sausages, ice-creams and sauces. It is also used in dying, colic printing, setting lotions and cosmetic industries. The embryo oil of seed having 50 per cent linoleic acid which prevents arteriosclerosis, oil is more active than safflower oil, which reduces the serum cholesterol level in the rabbits (Atal and Kapoor, 1964)

The study on character association has been suggested to be an important strategy to break negative genetic barrier to yield whereas, correlation studies would provide estimate of degree of association between seed yield and its various components.

## 2. Material and methods

The field experiment was conducted during the rabi season 2006-07 at Scheme for Medicinal and Aromatic Plants, Department of Botany, MPKV, Rahuri-413722, District Ahmednagar (M.S.) (19°47' N, $74^0$81' E, 657.19 above M.S.L.). The topography of field was uniform and leveled. The experiment was conducted in the Randomised Block Design with six treatments replicated four times. The gross plot size was 3.60 x 3 $m^2$.The allocation of six treatments in four replications. The sowing was carried out by dibbling 2-3 seeds at each hill on 15th December 2006 with 30 x 10 cm spacing. There are three varieties are sown namely GI- 1, HI- 5, Niharika. Two different fertilizer doses are used for study 1. 50 : 25 : 0 out of which ½ N + complete dose of P at the time of sowing and ½N 21 days after sowing. 2. 100 : 50 : 0 out of which ½N + complete dose of P at the time of sowing and ½N at the time of 21 days after sowing. Gap filling was carried out 15 days after sowing (DAS) while thinning was done 25 days after sowing by keeping one healthy seedling at each hill. The recommended plant protection measures were undertaken whenever necessary. The border line of each plot where harvested first then. Five sample plants from different rows of each plot were harvested separately and bagged properly after labelling it. Studies on various physiological growth analyses were made at 30, 45, 60, 75 and 90 days after sowing as under leaf area index expression of leaf surface to the ground area occupied by the crop. The ratio of increase in dry matter per unit of dry mater present.In post-harvest analysis measure yield components namely Number of productive tillers/plant, Total number of spikes/plant, Number of seed/spike, Seed weight/spike (g), Husk yield/plant (g), 1000 seed weight (g), Yield per net plot (g) and per ha (kg), Total biomass/plot (g), Harvest Index, Swelling factor.

# 3. Experimental result

## Growth studies

Growth contributing characters viz., plant height, Number of tillers, leaf area, leaf area index, Leaf area DurationFound to be the variety $V_2$ (HI-5) had consistently and significantly higher plant height than the variety $V_1$ (GI-1) and $V_3$ (Niharika) at all the observational occasions. Similarly the fertilizer level $L_2$ had consistently and significantly higher plant height than the fertilizer level $L_1$ at all the crop growth stages.The height of the plant and days to different growth stages were also influenced by the fertility levels. The height of the plant increase significantly with increasing the fertility levels.Similar increase in plant height due to fertility levels was reported by Randhawa et al. (1978), Singh *et al*. (1994) and Maheshwari*et al*. (2000). Further, Sharma *et al*. (2003), Singh *et al*. (2003b) and Utgikar et al. (2003) also recorded the similarresults.

The varieties differed significantly in respect of Production of productive tillers per plant. The variety V3 (Niharika) produced significantly more productive tillers, whereas Variety V1(GI-1) and V2(HI-5) had lower number of productive tillers. The interaction effect between varieties and fertilizers levels for number of productive tillers was found to be significant.

It is clear from the above discussion that seed yield differences under higher fertility level of different varieties was not mainly because of reduction in number of productive tillers Per plant but may be due to other yield contributing characters as the seed yield per plant depends upon total number of spikes Per plant and number of seed per spike. Increase of fertilizers levels don't influence significantly on number of spikelets per spike and productive tillers per plant . Maximum spikelets number per spike was Observed in V3 ( Niharika ) variety whereas minimum in V1 ( GI-1 ) Variety . This observation , therefore confirms the results reported by Utgikar*et al . ( 2003 ).*

The variety $V_3$ (Niharika) had consistently and significantly higher leaf area per plant than the variety $V_1$(GI-1) and $V_2$ (HI-5) At all the observational occasions. similarly, the fertilizer level $L_2$ had consistently and significantly higher leaf area than the fertilizer level $L_1$ at all the crop growth stages.Leaf area revealed that the leaf area per plant was increased with increase in fertilizer levels throughout the growth period. Because of increased leaf area, total photosynthates produced by the plant might have been more as a result total dry matter yield per plant must have been increased. The Leaf Area Duration was increased due to increase in leaf area per plant.Ramesh et al. (1989), Solanki and Shaktawat (1999) andUtgikar*et al.* (2003) reported same result in case of effect of increasing fertilizer level on leaf area. Similar results were reported by Khalifa (1973) that early nitrogen application effectively increased by LAD by increasing LAI.

The mean leaf areas index of Isabgol genotype during 30,45,60 and 75 DAS, was 1.027,1.395,1.818 and 1.850 $dm^2$ $plant^{-1}$ respectively. The mean maximum leaf area index observed at 75 day of crop growth stage which showed that with increase in growth period upto 75 days increase leaf area index. Treatment combination $V_3L_2$ showed maximum leaf are index whereas, treatment $V_1L_1$ (GI-1, 50:25NP) recorded minimum leaf area index.

The mean leaf area duration of Isbgol genotype during 30-45,45-60 and 60-75 DAS was 17.998, 24.064 and 27.589 (days) respectively. The mean maximum leaf area index observed at 60-75 days of crop growth stage which showed that leaf area duration reaches highest at 60-75 DAS.Highest mean leaf area duration observed at treatment $V_3L_2$(Niharika, 100:50NP) and lowest leaf area duration observed at treatment combination $V_1L_1$(GI-1 50:25 NP).

The seed yield due to varietal differences were significant per net plot and significantly for per hectare. Numerically highest yield per hectare was observed in variety V3 (Niharika) while the lowest yield per hectare was observed in variety $V_2$(HI-5).Fertilizer differences were non-significant for seed yield per net plot and for seed yield per hectare.The interaction effects were non-significant respectively for seed yield per net plot and per hectare.The fertilizer level, their was liner increase in yiled, Similar result reported by Randhawa*et al.* (1978). They found that highest seed yield Of Isabgol with nitrogen application @20 or 40 kg $ha^{-1}$. Solanki and Shaktawat (1999) also found that 45 kg N $ha^{-1}$Significantly increased seed yield over control. Further Bist*et al.* (2001), Rathore and Chandawat (2003) and Utgikar*etal.* (2003) reported same results.

# 4. Conclusion

Among the three genotypes, variety $V_3$ (Niharika) responded well to fertilizer level resulting in significant increase in growth and yield contributing characters.

Fertilizer dose 100:25 NP kg/ha increased growth, yield and quality characters but, at par with 50:25 NP kg/ha fertilizer dose. Recorded data numerically higher but statistically non-significant. Therefore, application of 50:25 NP kg/ha dose may be useful for increase the yield and quality characters.

The combination of $V_3$ (Niharika) variety and 50:25 NP kg/ha dose significantly increased all the growth and yield characters. It would be, therefore, advisable apply 50:25 NP kg/ha dose to Niharika genotype.

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# Mean plant height (cm) of main shoot of Isabgol genotype

| Treatment | Days after sowing | | | |
|---|---|---|---|---|
| | 30 | 45 | 60 | 75 |
| **A. Varieties** | | | | |
| V1: GI-1 | 15.82 | 20.50 | 25.55 | 26.55 |
| V2: HI-5 | 18.75 | 22.90 | 28.54 | 29.53 |
| V3: Niharika | 17.73 | 22.05 | 26.31 | 27.31 |
| S.E ± | 0.090 | 0.190 | 0.143 | 0.140 |
| CD at 5% | 0.280 | 0.600 | 0.431 | 0.430 |
| **B. Fertilizer dose(kg ha$^{-1}$)** | | | | |
| $L_1$:50:25 NP | 16.37 | 21.14 | 24.81 | 25.80 |
| $L_2$:100:50 NP | 18.50 | 22.49 | 28.79 | 29.79 |
| S.E ± | 0.070 | 0.160 | 0.117 | 0.118 |
| CD at 5% | 0.230 | 0.490 | 0.352 | 0.355 |
| **C. Interaction (A x B)** | | | | |
| S.E ± | 0.130 | 0.282 | 0.202 | 0.204 |

| | | | | |
|---|---|---|---|---|
| CD at 5% | 0.400 | 0.449 | 0.610 | 0.615 |

# Mean number of tillers of Isabgol genotype

| Treatment | Days after sowing | | | |
|---|---|---|---|---|
| | 30 | 45 | 60 | 75 |
| **A. Varieites** | | | | |
| $V_1$: GI-1 | 3.12 (1.89) | 3.87 (2.08) | 4.00 (2.12) | 4.95 (2.35) |
| $V_2$: HI-5 | 3.56 (2.01) | 4.02 (2.12) | 4.65 (2.26) | 5.40 (2.44) |
| $V_3$: Niharika | 3.58 (2.00) | 4.45 (2.21) | 5.15 (2.37) | 5.48 (2.44) |
| S.E ± | 0.128 (0.031) | 0.088 (0.019) | 0.107 (0.024) | 0.110 (0.220) |
| CD at 5% | 0.385 (0.095) | 0.264 (0.058) | 0.324 (0.072) | 0.331 (0.066) |
| **B. Fertilizer dose (kg ha$^{-1}$)** | | | | |
| $L_1$:50:25 NP | 3.23 (1.93) | 3.83 (2.08) | 4.36 (2.20) | 5.06 (2.35) |
| $L_2$:100:50 NP | 3.61 (2.02) | 4.40 (2.21) | 4.86 (2.31) | 5.49 (2.44) |
| S.E ± | 0.140 (0.046) | 0.210 (0.063) | 0.193 (0.060) | 0.173 (0.170) |
| CD at 5% | N.S | N.S | N.S | N.S |

| **C. Interaction (A×B)** | | | | |
|---|---|---|---|---|
| S.E ± | 0.181 (0.044) | 0.124 (0.027) | 0.152 (0.034) | 0.155 (0.031) |
| CD at 5% | N.S | N.S | 0.458 (0.102) | 0.468 (0.094) |

# Mean leaf area ($dm^2$) of Isabgol genotype

| **Treatment** | **Days after sowing** | | | |
|---|---|---|---|---|
| | **30** | **45** | **60** | **75** |
| **A. Varieties** | | | | |
| $V_1$: GI-1 | 2.59 | 3.87 | 4.90 | 4.94 |
| $V_2$: HI-5 | 3.10 | 4.07 | 5.58 | 5.68 |
| $V_3$: Niharika | 3.37 | 4.64 | 5.92 | 6.08 |
| S.E ± | 0.082 | 0.087 | 0.102 | 0.121 |
| CD at 5 % | 0.247 | 0.261 | 0.307 | 0.364 |
| **A. Fertilizer dose (kg $ha^{-1)}$** | | | | |
| $L_1$ : 50: 25 NP | 2.61 | 3.72 | 4.68 | 4.73 |
| $L_2$ : 100: 50 NP | 3.42 | 4.67 | 6.25 | 6.40 |
| S.E ± | 0.067 | 0.071 | 0.083 | 0.099 |

| | | | | |
|---|---|---|---|---|
| CD at 5 % | 0.202 | 0.213 | 0.250 | 0.297 |
| **B. Interaction (A x B)** | | | | |
| S.E ± | 0.116 | 0.123 | 0.144 | 0.171 |
| CD at 5 % | N.S | N.S | 0.433 | 0.514 |

# Mean leaf area index of Isbagol genotype

| Sr. | Treatment | Days after sowing | | | |
|---|---|---|---|---|---|
| | | 30 | 45 | 60 | 75 |
| 1 | $V_1L_1$ (GI-1 50:25NP) | 0.962 | 1.140 | 1.400 | 1.410 |
| 2 | $V_1L_2$ (GI-1 100:50NP) | 1.083 | 1.460 | 1.740 | 1.760 |
| 3 | $V_2L_1$ (HI-5 50:25NP) | 0.696 | 1.110 | 1.530 | 1.560 |
| 4 | $V_2L_2$ (HI-5 100:50NP) | 0.893 | 1.440 | 1.870 | 1.880 |
| 5 | $V_3L_1$ (Niharika50:25NP) | 0.983 | 1.240 | 1.970 | 2.000 |
| 6 | $V_3L_2$ (Niharika 100:50NP) | 1.550 | 1.980 | 2.400 | 2.490 |
| 7 | Mean | 1.027 | 1.395 | 1.818 | 1.850 |

# Mean leaf area Duration (days) of Isabgol genotype

| Sr. | Treatment | Days after sowing | | |
|---|---|---|---|---|
| | | 30 – 45 | 45-60 | 60-75 |
| 1 | $V_1L_1$ (GI-1 50:25NP) | 14.820 | 19.050 | 21.670 |
| 2 | $V_1L_2$ (GI-1 100:50NP) | 19.005 | 24.000 | 26.250 |

| | | | | |
|---|---|---|---|---|
| 3 | $V_2L_1$ (HI-5 50:25NP) | 13.540 | 19.665 | 23.170 |
| 4 | $V_2L_2$ (HI-5 100:50NP) | 17.490 | 24.820 | 28.120 |
| 5 | $V_3L_1$ (Niharika50:25NP) | 16.670 | 24.000 | 29.770 |
| 6 | $V_3L_2$ (Niharika100:50NP) | 26.465 | 32.850 | 36.555 |
| 7 | Mean | 17.998 | 24.064 | 27.589 |