CHAPTER-V

DISCUSSION
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Agricultural research are mainly concerned to increase the productivity of crops by improving the growth and development of crop plants. Present study was emphasized to manipulate the planting density and fertilizer requirement of Isabgol to step-up the productivity of crop. In general productivity of crop is highly influenced by genetic and environmental factors. Genetic factor consists with expression of varietals characters to produce the yields. The yielding potential of any crop variety, each genetic behavior and it is beyond the control of growers. Only growing of a high yielding crop variety is seldom to increase its potentials yields. The second factor i.e. environmental factors consist with climate, soil and managerial practices and they play vital role in improving the productivity of crops, besides the effect of crop variety. The climatic conditions and soils characteristics are natural and thus, they can not be changed easily to improve the productivity of crop. But adjustment of managerial factors viz. land preparation, sowing management (sowing time, seed rate, sowing method, planting densities and planting geometry etc.), nutrient management i.e. application of manures and fertilizers, plant protection measures for efficient weed controls, insect control and disease control; water management etc. in relation to existing weather parameters and soil features had concern to improve the productivity of crops.
In present investigation planting densities as seed rates and fertility levels as fertilizer doses were variable treatments to find out their effects on growth and yield of crop in both years. Huge data were generated and the results are described in previous chapter. Some of the results have value of very high important for academic interest as well as practical concern to increase the yield. Such valuable results are discussed in this chapter with the support of data, scientific facts and views of other workers. The effect of weather and soil conditions have certainly most important concern, hence, their influence on crop yields have been also discussed here.

**Effect of weather conditions:**

Weather parameters viz. maximum and minimum temperatures, rainfall, rainy days and relative humidity etc. prevailed in the experimental during crop seasons in both years were recorded. In general, the weather condition were almost identical to average condition of these parameters in the locality (Table 1 and figure 1). As a whole, the weather condition were congenial for the growth and development and their yield of the crop under all treatments uniformly. Thus, it could be said the weather conditions did not cause any particular effect on the growth and productivity of crops. However if any variations in growth and yield was recorded it might be due to the effect of treatments tried in the present investigation and not by the effect of any climatic deviation.
Effect of soils:

The experiments were conducted on farmer's field having homogenous fertility status (Table 2). According to previous cropping history in the experimental field, uniform corps and cropping system were practice with a common dose of fertilizer application before using the land under present studies. Thus, it could be concluded that the treatments had exerted their individual effects on growth and yield of crops.

Crop Stand:

Plant population per unit area has direct effect on the growth and productivity of crop plants. Plant density was one of the factors to study their effects on growth and yield of crop. To create variations in plant densities, three seed rates i.e. 6, 8 and 10 kg seeds/ha were tested in the present investigation. Plant population/m² was minimum (110 plant/m²) with 6 kg seeds/ha in both years of experimentation (Table 3). The plant population/m² significantly increased as 31.81 and 72.72;45.45 and 68.18% due to 8 and 10 kg seeds/ha, respectively over 6 kg seeds/ha in two consecutive years. Higher seed rates used with 8 and 10 kg seed rates/ha resulted into higher plant densities with them. But plant population did not deviate due to varying fertilizer doses applied under present investigation. The interaction effects of seed rates and fertilizer levels were also found to be non significant. It means, different fertilizer doses did not
cause any adverse effect on germination and further growth and development of crop plants. Meanwhile, every fertilizer doses had almost similar effects on the germination and further establishment of seedlings as well as growth of crop plants. These results are in close conformity with the findings of Sharma et al. (2001).

**Growth Pattern of Crop plants:**

Though plant population/m² varied due to different treatments, the growth of plants (plant-heights, leaf area and tillers/m²) was almost in the same pattern under different treatments in both years. Plant height gradually increased up to final (maturity) stage under all treatments, but the rate of increase in plant height was very less during the period between 90 DAS to maturity stage (Table 4) Leaf area index also ordinary increased with the advancement in growth stages of crop under all treatments in both years (Table 6). The rates of increase in LAI was uniform up to 60 DAS growth stage of crop, but LAI declined at 90 DAS growth stage under all treatments over its value of 60 DAS growth stage. The older leaves dried and emergence of new leaves stopped after 60 DAS growth stage of crop under all treatments which resulted into reduction of LAI at advanced growth stage. Number of tillers/m² also successively increased with the advancement in growth stages up to final stage during both years under all treatments (Table 5). The rate of increase in tillers count was maximum during the period 30 to 60 DAS under all treatments,
and thereafter the rate of increase in tiller counts was declined. The plants attained the reproductive phase after 60 DAS which might be the reason for slowing the tiller formation in the plants.

**Growth Characters of Crop:**

Growth characters viz. plant height and total number of tillers/m² and LAI did not differ markedly due to different plant densities. Though the number of tillers/m² were numerically lower with 6 kg seeds/ha than 8 and 10 kg seeds/ha, the values reversed at advanced growth stages (Table 5). Dry matter production /m² by the plants did not differed due to different seed rate. These results reveal that growth parameters did not deviate due to varying seed rates used for sowing. Tillers emerged with low seed rate (6 kg/ha) compensated the loss in plant densities because of efficient utilization of space, nutrient, moisture and light.

Plant height (Table 4) also did not vary due to varying fertility levels at all growth stages including final stage. But, total tillers/m² (Table 5) and LAI (Table 6) significantly varied due to fertility levels. Number of tillers and LAI were minimum with 0:0 kg NP/ha consistently in both years. The values on these growth parameters showed corresponding increase up to 50:50 kg NP/ha increase of tillers/m² and up to 75:75 kg NP/ha in case of LAI. The variation in tillers/m² between 25:25, 50:50 and 75:75 kg NP/ha were not significant at all growth stages up to final stages. In case of LAI, the
values significantly increased up to 50:50 kg NP/ha and further increase in fertilizers dose as 75:75 kg NP/ha did not show the significance. Application of required quantity of major plant nutrients particularly N and P resulted in to more absorption of food materials by the crop plants. It is established fact that nitrogen is constituent of protein and thus helps formation of cells. Further it helps in cell-division and thus. It is an important growth promoting plant nutrients. Its application to a desirable limit resulted in to increase in plant height, leaf size and number of tillers. Phosphorus is essential elements which helps in ATP formation for increasing the nutrient uptake by the plants. It accelerates the development of root and shoot promodia in the plants which ultimately enhance the uptake of food materials and moisture by the plants. Because of efficient utilization of N and P, the number and size of leaves increased in the plants. Those contribute to increase photosynthetic activity. More accumulation of photosynthesis and food materials in the plants, due to application of adequate quantity of N and P resulted in to production of improved growth parameters.

Dry Matter (DM) production/m² by the plants significantly varied due to varying fertility levels (Table 7). Generally DM production/m² was minimum with no use of N and P fertilizers which increase correspondingly with every incremental levels of fertilizers as 25:25, 50:50 and 75:75 kg NP/ha, but variations in DM accumulation
Showing normal crop stand (Plate 5) and normal earhead (Plate 6)
by the plants were not much between the closer levels of fertilizers doses. Accumulation of more photosynthesis and food materials with the use of efficient level of N and P fertilizers attributed to produce higher quantity of DM. Similar improvement in growth parameters of plants in isabgol and other resembling crop due to application of N and P fertilizers have been reported by other workers also (Ramesh et al. 1989, Singh et al. 1991, Ramesh et al. 1992, Patel et al. 1996, Mann and Vyas 1999, Maheshwari et al. 2000).

Yield attributing Characters:

Studies on important yield attributing characters viz. spike/m², spike length, number of seeds/spike, and 1000 seed weight were made in relation to different seed rate and fertilizer doses (Table 8). Number of spike/m² at maturity did not differ due to varying seed rates (plant densities). Though initial plant population were quite less due to lower seed rates, the widely spaced plants favoured much to produce the tillers which compensated the total ear head (spike) producing tillers. Consequently number of spike/m² were almost similar with all seed rates. It was notable that length of spikes were greater with low seed rate (6 kg/ha) which significantly reduced by increasing the seed rates. The tillers emerged from the main shoot might be responsible for producing the longer spikes than those emerged directly from main shoots. Consequence upon large spikes produced by low seed rates, the number of seeds/spike also higher
with this treatment then that higher seed rates. The shorter spike length with high seed rates resulted and in to produce lesser number of seeds/spike. The test weight of seeds was un affected by different seed rates. Better growth of plants with low seed rates due to efficient utilization of light, space, nutrient and moisture contributed to produce longer sized spikes with increased number of seeds. These results are in close conformity with the finding of Randhwa et al. (1978), Mehta et al. (1976), McNell (1999), Sharma et al. (2001).

Number of spikes/m² significantly increased due to application of fertilizers than control (0:0 kg NP/ha) in both years, but variations between varying fertility levels i.e. 25:25, 50:50 and 75:75 kg NP/ha were not much. Improvement in dry matter production and LAI (Photosynthetic formation) with the application of fertilizers have resulted in to production of increased number of tillers/m² which attributed to produce higher number of spikes/m². The variations in number of tillers/m² between varying fertilizers doses were not much, thereby number of spikes/m² also did not differ due to them. Increasing levels of fertilizers application as 0:0, 25:25 and 50:50 kg NP/ha exhibited corresponding increase in length of spike during both years, but further increment in fertilizers dose as 75:75 kg NP/ha did not help to increase in the length of spikes even it had a slight reduction in the length of spike probably due, competition of nutrients and water. The number of seeds/spike is directly related with length
of spike. As a consequence, number of seeds/spike followed the same trend as to length of spikes due to different fertilizer doses. The seeds counts/spike were minimum with unfertilized treatment, because of small spike and it increased significantly with increasing levels of fertilizer doses up to 50:50 kg NP/ha. However, the length of spike slightly shortened with further increase in fertilizer dose as 75:75 kg NP/ha which attributed to produce lesser number of seeds/spike. The test weight of seeds (1000) did not vary due to varying fertility levels, although the weight of seeds numerically increased with higher levels of fertilizers doses. Fertilizer application to crop resulted to produce good growth of plants with probably helped to produced superior yield attributing characters mainly number of spikes/m2 and number of seeds/spike. These results also corroborated the findings of Modi et al. (1974), Randhawa et al. (1978), Ramesh et al. (1989) and Singh et al. (1981).

**Biomass production:**

It includes total weight of grain (economic output) and straw both. Though straw is not much directly concern with economics from farmers point of view, it has certainly much relevance with growth habit of the plants. In agriculture plants are grown for a particular purpose and that out put is known economic yield. The higher ratio of economic yield in total biomass is generally considered better. This index is term as harvest index (HI) in agricultural research. The HI
values did not differ due to different treatments (i.e. seed rates and fertility levels) in present investigation (Table 11). This gives an indicative that proportion of grain in total biomass was almost same under all treatments. Any variability developed by the treatments had no remarkable influence of HI values. Similar results have been reported by the agricultural scientist from their studies in different field crops with regarded to HI (Thakuria and gogoi 2000, Arya, and Singh, 20001 and Mann and Vyas 2001).

**Grain and Straw yields:**

From the above discussion, it is obvious that both grain and straw yields were in the same pattern under different treatments. The vegetative growth parameters viz. plant height, number of tillers/m² and DM production by plants/m² had their direct correlation with biomass production. But number of spike/m², seeds/spike and test weight of seeds had their strong association ships with seed yields for which the tested crop was grown.

**Straw Yields:**

Straw yields were maximum with low plant density (6 kg/ha) in both years and it reduced correspondingly with increasing the seed rates as 8 and 10 kg/ha, but differences did not reach to the level of significance. Based on two years mean data, the straw yields were 35.67 q/ha with 6 kg seeds/ha which reduced in terms of 32.76 and
28.86 q/ha due to 8 and 10 kg seeds/ha, respectively. Though plant population were less with low seed rate (6 kg/ha) than higher seed rates, the growth parameters viz. plant height and tillers/m² increased due to efficient utilization of resources like space, nutrient, moisture and light. Thus total biomass production at harvest mostly equalized under all seed rates and even increased with low seed rates. These growth parameters significantly increased with fertilizer application, over no fertilizer application, but the rate of increase was not much due to further incremental levels of fertilizers. As discussed earlier, application of adequate quantity of fertilizer nutrients attributed to better growth of crop plants, therefore the straw yields increased. Because of marginal rate of increase in growth parameters with further addition of fertilizers, the variation between the closer fertilizer levels did not show their remarkable influence.

**Seed Yields:**

Based on two year data seed or grain yields were maximum (18.54 q/ha) with 6 kg seeds/ha which reduced by 13.96 and 19.30% due to 8 and 10 kg seeds/ha. The trend of seed yields due to different seed rates was almost same in both years. Production of increased number of spikes/m² and number of seeds/spike with low seed rate (6 kg/ha) ascribed to increase seed yields. The deterioration in these yield attributing characters due to further increase in seed rates as 8 and 10 kg/ha resulted into reduction in the seed yields. These
results also corroborated the findings of Randhawa et al. 1978 and Sharma et al. (2001).

Application of fertilizer had shown its marked influenced on seed yield of this crop. It was minimum (13.53 q/ha) with 0:0 kg NP/ha and increased by 7.83, 39.54 and 40.20% due to 25:25, 50:50 and 75:75 kg NP/ha, respectively. It means seed yields increased correspondingly with every incremental levels of fertilizers upto the highest levels, but differences between closer levels i.e. 0:0 and 25:25, or 25:25 and 50:50 or 50:50 and 75:75 kg NP/ha were not much. Improvement in yield attributing characters with increasing levels of fertilizers application because of good growth of crop plants attributed to increase seed yields. These results are in close conformity with the finding of Modi et al. (1974), Ramesh et al. (1989), Singh et al. (1991), Parihar and Singh (1995) Patel et al. (1996), Maheshwari et al. (2000) and Mann and Vyas (2001).

**Economic Viability of the treatments:**

Assessment of economic value of the treatments has great concern with practical utility of the investigation on farmers point of view. Economic assessment of the treatments consist with mainly cost of cultivation and net monetary return (NMR) per unit area as well as benefit-cost (B:C) ratio.
Cost of cultivation:

Farmers have varying economic status. Some are poor while others are rich. Economically poor farmers are unable to afford much investment on use of agro-inputs/operations viz. tillage, seeds, fertilizers, pesticides etc. The treatments involving with investment with considerably good yields may be cost efficient cultivation. Newly Rs. 7000/ha use in needed to great list got any for common inputs other than the variable inputs (appendix 1). The cost of cultivation varied due to varying seed rates. Low seed rates required less investment (Rs. 11668/ha) these higher seed rates as 8 (Rs. 12668/ha) and 10 (Rs. 13668/ha) kg seeds/ha. The seeds of isabgol are very costly (Rs. 500/kg) at present, hence it had much variation due to varying seed rates, but it may not have much variation in further when this crop would be cultivation in conventional manner by several produces. Fertilizers are not only the cost agro-inputs, but it is non-renewable nature of energy. Hence the cost of cultivation greatly influenced by varying fertilizer doses. The control plot needed the lowest investment (Rs. 11000/ha) which increased as Rs. 11843, 12498 and 13663/ha due to 25:25, 50:50 and 75:75 kg NP/ha respectively.
Net Monetary Return:

It is an actual monetary gains to the growers, because it is worked out by subtracting the cost of cultivation from the gross monetary grain in an unit area. The NMR varied due to varying treatments. However minimum (Rs. 25312/ha) with 6 kg seeds/ha which reduced as Rs. 18692 and 16912/ha due to 8 and 10 kg seeds/ha, respectively. Less yields with higher investment under higher seeds rates was the reason for less NMR. It is most remarkable here that this crop has ability to give higher economic produce with less investment with reference to seed.

The NMR was in the lowest with control i.e. 0:0 kg NP/ha (Rs. 16060/ha) which increase as Rs. 17337, 25262 and 24277/ha due to 25:25, 50:50 and 75:75 kg NP/ha, respectively. This shows that cultivation of this crop with the use of fertilizers was quite remunerative. However, the NMR value showed declining trend with the application of fertilizers beyond 50:50 up kg NP/ha. Thus, it could be said that use of very high dose of fertilizers to this crop was uneconomical. The cost of expenditure on fertilizers increased with the increased level of fertilizer application, but the value of produced did not increase proportionately beyond 50:50 kg NP/ha. Thus, it could be said that application of fertilizer beyond 50:50 kg NP/ha was not good in this crop.
**Benefit-cost ratio:**

It is also known as profitability. It is gain of each rupee of investment under different treatments. The B:C ratio was maximum (3.16) with 6 kg seeds/ha among all seed rates on the basis of two years data. The indices reduced as 2.47 and 2.23 due to 8 and 10 kg seeds/ha, respectively. Thus, it could be said that using higher seed rate reduced the profitability. Cultivation of this crop may be more useful for poor growers, because it has potential in step-up this monetary advantages with low investment. The B:C ratio also varied remarkably by varying fertility levels. It was minimum (2.46) with control and even low fertility level (25:25 kg NP/ha). Which increased as 3.02 and 2.77 due to 50:50 and 75:75 kg NP/ha, respectively. It gives an indication that although profitability increased up to the highest levels of fertility (75:75 kg NP/ha), the rate of profitability was not much remunerative beyond 50:50 kg NP/ha.

Which considering the effect of treatment combination the lowest cost of cultivation (Rs. 10,000/ha was with 6 kg seeds + 0.00 kg NP/ha) but it was maximum (Rs. 14,683/ha with 10 kg seeds + 75:75 kg NP/ha). As regards, the NMR, the value was minimum (Rs. 13796/ha) with 10 kg seeds + 25:25 kg NP/ha. The higher NMR (Rs. 31842/ha) was recorded with 6 kg seeds + 50:50 kg NP/ha. The NMR with 6 kg seeds + 0.0 kg NP/ha was Rs. 19840/ha, when this was quite low by using 25:25 by NP/ha with 8 and 10 kg seeds/ha. Thus,
it could be understood that low seed rate contributed more to economics in cultivation of Isabgol. The B:C ratio followed almost the same trend as to NMR under different treatments. Because it is directly related with cost of cultivation and total monetary gain those are used in determining the NMR.