CHAPTER - VI

SUMMARY AND CONCLUSION
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SUMMARY

The present investigation entitled "Effect of soil-tilth, seed inoculation and sowing methods on growth and yield of soybean (Glycine max Linn. Merrill.)" was conducted at Regional Agricultural Research Station, Sagar, M.P. during kharif 1989-90 and 1990-91. The main objectives of the investigation were to find out the ideal and economic tillage operation, method of sowing and nitrogen fertilization in soybean cultivation.

The soil of the experimental field is clayey. It has homogenous fertility status and uniform topography with a gentle slope. The pH of the soil was moderately alkaline (8.25). It had medium (401.48 Kg N/ha), low (9.24 Kg P₂O₅/ha) and high (425.92 Kg K₂O/ha) available nitrogen, phosphorus and potassium contents respectively.

The climatic conditions consisted of semi-humid and sub-tropical features. The weather conditions prevailed during both the years of experimentation were almost normal for the growth and yield of soybean crop under rainfed situations. Maximum and minimum temperatures were almost favourable for the crop growth during both the years. But the rainfall during crop growth season (June to October)
was 499.45 and 1585.60 mm in the two consecutive years of the investigation as against 1300 mm average rainfall during the same period.

Total sixteen treatments consisted with two soil-tilth (no tillage - destruction of germinated weeds by pre-sowing application of paraquat, adequate tillage-land preparation with use of tractor driven implements in order of duckfoot cultivator two pass + disc harrow one pass + leveller one pass) and two sowing methods (line and broadcast sowing) as main treatments and four inoculation (no-inoculation and no nitrogen, *Rhizobium* culture inoculation, 20 Kg N/ha and *Rhizobium* culture inoculation + 20 Kg N/ha) as sub treatments were laid out in a split plot design with four replications. Soil-tilth were obtained as per treatment. Crop cv. Gaurav (JS 72-44) was sown with seed rate of 100 Kg/ha on July 2 and 10 in the two consecutive years. In line sowing method, rows were kept at 30 cm apart. An uniform dose of 60 Kg P₂O₅ and 20 Kg K₂O/ha were given through single super phosphate and muriate of potash respectively as basal dose in all treatment plots. Nitrogen was also applied along with them through urea as per treatments. Seeds were treated with *Rhizobium japonicum* bacterial culture at the rate of 5 g/kg seed as per treatments just before sowing. Weed control and plant protection measures were followed uniformly in all treatment plots.
Five plants were randomly removed from the each treatment plot at 30, 60, 90 DAS and finally at maturity stages for various physiological growth rate studies in border area of plot. Five plants were also tagged randomly for different studies on growth characters and yield attributes. Finally, grain and straw yields were recorded plot wise. Various studies on soil properties and chemical properties of produce were made in the laboratories. Data pertaining to above observations were tabulated and subjected for statistical analysis. The findings of the investigation have focussed many interesting facts which are summarised below:

GROWTH CHARACTERS:

Plant population/m² were generally uniform under different soil-tilth and inoculation treatments. But line sowing methods of sowing had resulted into higher plant densities over broadcasting as a result of placement of seeds at proper depth under this method.

Growth characters viz. plant-height, number of basal branches per plant, LAI and DM accumulation rate increased at a steady rate till the final stage. But plant-height, branches per plant and LAI increased with rapid rate upto 60 DAS and then declined slowly. DM accumulation rate increased slowly upto 30 DAS and then the rate of increase became rapid upto 90 DAS and thereafter it declined
slowly. The influence of various treatments on these growth parameters was evaluated at various growth stages.

Neither different soil-tilth nor sowing methods caused their marked influence on these growth parameters at all growth stages during both the years though, the values were numerically higher in adequate tillage among the soil-tilth and in line sowing among the sowing methods. These growth parameters were found markedly inferior under control (no inoculation and no nitrogen application) treatment than the treatments receiving either inoculation or nitrogen alone or in combination with each other.

It is notable that nodulation was most ideal when crop growth was good and nitrogen or inoculation was given to the crop.

**PHYSIOLOGICAL GROWTH RATE ANALYSIS**:

CGR increased upto 60 DAS growth stage and then declined till the maturity. Thus, it exhibited a sigmoid pattern growth. In general, CGR value was not markedly affected by different tillage operations as well as sowing methods at all growth stages during both the years. Though, the values were numerically greater under adequate tillage over no tillage and under line sowing method over broadcast sowing as well. The plots treated with either inoculation or 20 Kg N/ha alone or with their combination had the higher CGR values than control.
RGR values were maximum at lag stage (30 DAS) and then reduced slowly till the maturity. RGR values were significantly influenced by different tillage operations and sowing methods till 60 DAS, but their effects were not significant after this stage. The values were greater under adequate tillage over no tillage. Similarly, line sowing method had higher RGR than broadcast method. RGR values did not differ markedly due to varying inoculation treatments.

**YIELD ATTRIBUTING CHARACTERS:**

Yield attributing characters viz. pods per plant, weight of pods per plant, seeds per pod, weight of seeds per pod, weight of seeds per plant, weight of straw per plant and test-weight did not differ significantly due to adequate and no tillage operations, though the values were superior in former. Similarly, these attributes were superior in line sowing treatment with non-significant differences. These yield attributes were significantly lowest under control plots (no inoculation and no nitrogen) which increased significantly in ascending order of inoculation of seed, application of 20 Kg N/ha and application of 20 Kg N/ha along with inoculation.

**SEED AND STRAW YIELDS:**

Generally, weather components did not cause any adverse effects on the growth and ultimately on the seed
and straw yields during both the years of the experimentation. But yields were nearly doubled under all the treatments during the year 1990-91 than the previous year because of early germination of rains at reproductive growth stage.

Adequately tilled seed bed condition gave the higher seed and straw yields during both the years than no tillage condition but the difference was not significant. The growth parameters and yield attributes were generally identical under both soil-tilth and thus, the yields did not differ much. Slightly higher plant population/m² under adequate tillage had probably proved its marginal superiority over no tillage.

Line sown crop significantly gave higher seed and straw yields over broadcast sown crop because of higher plant population/m². Line sowing method facilitated more ideal conditions to germination. Higher plant densities reflected to produce more photosynthetic area and attributed to superior growth and yield attributes.

Different inoculum and nitrogen application treatments did not show marked variations in seed and straw yields during the year 1989-90, though the yields were higher in the plots treated with either inoculation or 20 Kg N/ha alone or the combination of both than control. Yields were significantly increased in ascending order
of inoculation alone, 20 Kg N/ha alone and inoculation + 20 Kg N/ha.

Treatment consisted with adequate tillage, line sowing and application of 20 Kg N/ha along with inoculation produced maximum seed and straw yields during both the years. Whereas, combination of zero-tillage, broadcast sowing and control (no inoculation + no nitrogen) gave the lowest yields. Among the three factors tried in the investigation, sowing methods had profound influence on yields. Influence of inoculum and nitrogen application was next to it in order of positive preferences. Both tillage operations had their least influence on the yields. Hence, it could be said that tillage operations for preparation of seed bed can be eliminated without sacrificing the productivity by direct seeding in rows on weed free seed bed obtained with the use of paraquat @ 1 Kg a.i./ha before sowing.

HARVEST INDEX:

HI values did not differ due to the influence of various treatments in present investigation.

PROTEIN CONTENT:

Different treatments did not show marked variation in protein contents of seed and straw in soybean crop.
NPK STATUS OF THE SOIL:

Different treatments had no any marked influence to change the residual N-content of the soil after the harvest of the crop. But residual P and K contents reduced to a little extent by crop removal during both the years.

ECONOMICS OF THE TREATMENTS:

Soybean cultivation under zero tillage with broadcast sowing and no fertilizer management gained the lowest monetary return per hectare during both the years. Whereas, treatment combination of adequate tillage, line sowing and application of 20 Kg N/ha along with inoculation registered the maximum monetary return per hectare. The combinations of zero tillage, line sowing and inoculation + 20 Kg N/ha or 20 Kg N/ha alone were next to it.

While comparing the influence of treatments on net return per hectare, zero tillage proved markedly superior over adequate tillage. Similarly, line sowing method proved its marked superiority over broadcast sowing method with regard to net return per hectare. Use of bacterial inoculation or application of 20 Kg N/ha alone or combination of both fetched significantly higher net profit over control. Thus, it could be said that zero tillage gave consistently good profit, when sowing was done in rows even without use of nitrogen or inoculants. Benefit-cost ratio followed the same trend as followed
by the net monetary returns per hectare under all the treatments.

From over all picture of economic analysis, it could be asserted that cultivation of soybean under zero tillage by line sowing and with application of 20 Kg N/ha along with inoculation of seed proved to be profitable.

CONCLUSIONS:

1. Killing of germinating weeds by the spraying of paraquat @ 1 Kg a.e./ha before sowing provided the ideal and economical seed bed for cultivation of soybean under agroclimatic conditions of Sagar region.

2. Line sowing method accounted desirable plant density and provided suitable micro-ecosystem for good growth and yield of soybean crop.

3. Inoculation of bacterial culture on dry surface of seed before sowing gave nearly same seed yields of soybean as obtained due to application of 20 Kg N/ha. However, application of a little dose of nitrogen to stimulate the growth of plant at lag stage appeared to essential.

4. Cultivation of soybean by direct seeding in rows without any tillage after killing the weeds by the herbicide and with the use of 20 Kg N/ha or inoculation gave the optimum yields and profits.
5. Soybean grew with rapid growth rate upto 90 DAS and then declined slowly till the maturity. Both soil-tillage and sowing methods did cause marked influence on growth characters and physiological growth rate, but application of nitrogen or inoculation of seeds undoubtedly proved their superiority over no-nitrogen and no inoculation.

6. Treatments did not influence the protein content of seeds and plants in soybean.

7. Residual N-status of the soil after the harvest of soybean did not change due to the effect of the treatments but P and K contents reduced to a little extent consistently through crop removal.

8. Direct seeding in rows after killing the germinated weeds proved to be most economical for soybean cultivation. Maximum profit per hectare was recorded in soybean cultivation by direct seeding in rows with zero tillage and application of 20 Kg N/ha along with bacterial inoculation in seeds.