A detailed account of results obtained during the course of investigation entitled "Studies on seed crop of Fenugreek in relation to nitrogen (with and without inoculation), levels of phosphorus and cutting management" under conditions of Meerut region has been presented in the preceding chapter. An examination of the data reported therein reveals various points of great importance and academic interest which are discussed here in conjunction with the results of other workers. It may be pointed out that in these experiments greens and seed yield, to a considerable extent, showed a correlation with the growth observations, and it is felt that the assessment of experimental treatments by such data has been reasonably justified.

At the outset it may also be pointed out that the climatic conditions during the two cropping seasons (1992-93 and 1993-94) over which the experiments extended varied widely. In experiments where effect of nitrogen (with and without inoculation) and phosphatic fertilizers under various cutting managements are to be assessed, the weather conditions
are to affect the treatment effects and hence, variations in the meteorological data have also been given due consideration in this discussion.

5.1. CROP GROWTH AND ENVIRONMENT:

The important environmental factors which affect the growth of fenugreek are temperature, duration of seed production and intensity of sunlight (Gregory, 1926). These meteorological parameters pertaining to the growth period, November to April in both the years are given in Table 2, while the maximum and minimum temperatures are plotted against each week of every month (Fig.1).

Like most of the legumes, fenugreek is also sensitive to climatic changes. In case of this crop, active nitrogen fixation is dependant on the rate of carbon assimilation, which in turn, is governed by temperature, duration and intensity of light. As such the range of temperature which prevailed at sowing, nodule formation, flowering, pod setting and seed setting stages has been taken into consideration and discussed in details.

Reference to Table 2 will show that the range of maximum temperature (°C) was 30.0 to 31.0 in the first season and 28.5 to 30.1 in the second season, while that of minimum temperature (°C) it was 14.3 to 14.1 and 14.4 to 15.4 in first and second year, respectively during germination
period, slightly lower temperature which prevailed in the second season during early stages, seem to have promoted better and quick germination and early establishment of crop stand in that year. Because of this a better start of the crop, was possible and that might have resulted in superior growth as measured in terms of plant height and production of dry matter per plant in the second year.

Further examination of the data will reveal that during grand growth period, maximum temperature ranged from 28.6 to 21.9 °C in 1992-93 and 29.7 to 25.5 in 1993-94, while the minimum temperature during the year some period was 10.9 to 8.8°C in first season and 12.7 to 5.4°C in the second season, respectively. This indicates that the second year remained slightly cooler than first year during grand growth period. Since rhizobia do better service at low temperature (Borgohain et al., 1986), the second year was again better than the first one. Due to that yield of greens was higher in the second season than first season.

During later stages of crop growth particularly those coinciding with flowering and pod setting, the variations in the temperature differed more widely in the first year 111.6 to 107.4 days than in the second year 114.7 to 109.6 days and hence pod formation was not uniform during 1992-93 and possibly due to this production of seed
was somewhat poorer in the first year than in the second year.

Apart from temperature, rainfall is also known to affect growth, yield and quality of legume crops promote the growth of nodules and this formation of nodules is accelerated which, in turn, helps fixing atmospheric nitrogen (Habbish and Ishaq, 1974). Reference to Table 2 will show that in 1992-93, a total of 9.0 mm rainfall was received, while in 1993-94 precipitation amounted to 34.3 mm. Obviously the year 1993-94 was comparatively better for the experimental crop from rainfall point of view. Moreover, in the first cropping season lesser rainfall was received than the second year. The total precipitation of winter rains was higher in second year due to which the crop performance was observed superior under various growth, yield and quality parameters point of view than the previous one.

Besides a long dry spell of two fortnights which existed in the later part of the first crop season might have also affected crop adversely that forced to early maturity of the crop which reduced the seed yield of fenugreek.

From the above discussion it becomes reasonably clear that environmental conditions which prevailed in
1993-94 were more conducive for fenugreek growth and as a result of that yield level was higher as compared to that of 1992-93.

5.2. **GROWTH AND DEVELOPMENT**

The establishment and growth of crop plants depend on a sound root system. In view of this in Meerut region, where severe cold during winter season is occasionally a limiting factor, the studies on root development assume a significant place. It is also true to postulate the plants with better developed root system are able to absorb nutrients from deeper layer of the soil profile and hence they gain in weight and vigour. In the present study where fertility treatments on various cutting managements were involved, variations both in growth and developmental measurements were likely to occur. The significant variations obtained in these growth manifestations are certainly considered of interest and worthy of discussion.

5.2.1. **Nitrogen**:

Nitrogen, being the most mobile of all the mineral materials, is considered basis of all the life processes in plant system. Therefore, with adequate supply of nitrogen chlorophyll formation is positively affected resulting in the rapid rate of photosynthetic process within the plant. Consequently, increasing availability of nitrogen changes plant
structure, particularly plant growth (plant height, number of green leaves and branches, length of the longest branch and fresh and dry weight of plant biomass) and thus influence total amount of photosynthetic activities which are accelerated with an eventual increase in growth, yield and quality of fenugreek seed. Absorbed nitrogen and other nutrients combine with carbohydrate are urgently needed for building-up new tissues. Hence, nitrogen feeding accelerates plant structure favourably for high rate of nutrients absorption and not by their assimilation. In this way, nitrogen is one of the main factors responsible for productive metabolism in plants giving thereby maximum production.

Crop growth is limited, more often by the deficiency of nitrogen than any other nutrient. An increase in the nitrogen supply in the soil causes increased uptake of nitrogen by crop plant depending on the absorption capacities and its utilization for growth.

Fenugreek being a legume, is likely to make liberal use of atmospheric nitrogen by symbiotic process and thus, it may need very little application of nitrogen for its optimum growth and development. In the present experiment, 25 kg N/ha was applied as starter dose and this rate of nitrogen was compared with seed inoculation alone, inoculation + 25 kg N/ha and no nitrogen and no inoculation (control).
On reviewing the results (Table 16) it becomes quite clear that the starter dose of 25 kg N/ha alone did not show any improvement in the growth as judged by root development. It may also be seen that with application of 25 kg N/ha as starter dose, the root weight and length were neither affected significantly nor improved, whereas number of nodules was affected adversely. From these results it is clear that starter dose of nitrogen could not produce much additional advantage.

According to Dart (1974), Li (1974) and Bhangoo et al. (1976), nitrogen causes a depressive effect both on nodulation and rate of symbiotic fixation of nitrogen. Here, it may also be pointed out that with increased availability of nitrogen cell sap is somewhat reduced, which, in turn, has depressive effect on nodulation as advocated by Dart (1974), Li (1974) and Bhangoo and Prasad (1976). Obviously, Mynns (1968) reported that nitrate inhibits the formation of infection thread and nodules. They postulated that this inhibition is mainly due to the oxidation of IAA caused by nitrates produced by reduction of nitrogen added. In this contest Dart (1974) also inferred that nodulation is inhibited by nitrates/ammonia ions and such effect is more commonly observed at early stage in the infection process. These early effects may be related to inhibition of auxin
production near the infection sites and thus nitrogen applied during fixation leads to quite rapid loss of activity and nodule break-down.

However, it was interesting to note that with inoculation, number of nodules were remarkably improved over 25 kg N/ha and control, while remaining on par with inoculation + 25 kg N/ha. Further, root studies will show that treatment inoculation could not raise any consistent effect with 25 kg N/ha and inoculation + 25 kg N/ha on root weight and length of root to both the seasons. Obviously higher number of nodules dry weight and length of root were recorded with treatment inoculation + 25 kg N/ha.

It may be recalled that with inoculation + 25 kg N/ha appreciably improved plant height over all the nitrogenous treatments. Thereafter, in the present study the superiority of inoculation + 25 kg N/ha over 25 kg N/ha, inoculation alone and control was also to be noted significant at 60, 90, 120 days and at harvest to both the seasons. However, treatment inoculation alone could not bring any additional improvement in no. of green leaves/plant over inoculation + 25 kg N/ha at all the crop growth stages, whereas its superiority being noticed significant with 25 kg N/ha and control. The similar trend was noted on number of branches
per plant, length of the longest branch per plant, fresh weight (g) biomass per plant and dry matter accumulation per plant (g). Obviously, inoculation + 25 kg N/ha should be regarded enough from dry matter accumulation production point of view. It may be argued that with inoculation + 25 kg N/ha plants were of higher root weight and the production of nodule on roots was also of superior order and hence plants could be of superior vigour and growth with such a treatment (inoculation + 25 kg N/ha).

Consequently, fresh yield of greens (q/ha) and dry-matter content (%) was higher accelerated with treatment inoculation + 25 kg N/ha due to higher length of foliage and no. of branches/plant. Further, evinced that treatment inoculation + 25 kg N/ha was delayed the flowering, pod formation and physiological maturity of the crop (Crowther, 1935).

5.2.2. Phosphorus:

On the context of the growth data, it would be inferred that with application of phosphorus both roots and shoots of fenugreek plants were appreciably benefitted with every increase in the dose of phosphorus viz., 0 to 40 and 40 to 80 kg/ha. There was some improvement in the development of root, the maximum root length, of course, was
obtained with 80 kg rate. As expected with the maximum root length at 80 kg rate of phosphorus, the number of root nodules was also maximum. Further, due to the maximum root length and number of nodules formed the total dry matter production of roots was highest in plots receiving 80 kg rate of phosphorus. The usefulness and superiority of 80 kg rate over 40 kg and control are further elucidated when shoot growth measurements are taken into consideration. It may be inferred that the maximum benefit, as checked by plant height, number of green leaves, no. of branches per plant, length of the longest branch, fresh weight biomass per plant, dry matter accumulation per plant, fresh yield of greens, dry matter content % in greens accrued at the highest rate of phosphorus application. Obviously, from growth point of view, 80 kg rate of phosphorus appears to give the best responses. The utility and importance of phosphorus are further elucidated when the figures pertaining to dry matter accumulation per plant are examined. Here, it was interesting to note that though the improvement brought about by each successive increase in the dose of phosphorus, from 0 to 40 kg and 40 to 80 kg/ha, was of significant order the extent of increase was relatively higher with the latter rise (40 to 80 kg) in the rate of phosphorus. It may be argued that at 80 kg rate of phosphorus, plants might have
observed and utilized maximum amount of applied nutrients and hence, gained maximum weight. As the phosphorus rates increased, the duration of flowering, pod setting and physiological maturity was also decreased. Similar results were reported by Baboo et al., 1992 and Singh and Singh, 1989.

5.2.3. Cutting Management:

The main object to include the factor of cutting management in the present study was to establish relationship between plant population per unit area and growth of the crop plants under different fertility treatments. In this context some very useful results of practical utility were recorded which are discussed here as under:

It may be inferred that while reviewing the yield data, it may be assumed that the fenugreek crop require growth-arresting treatment, viz., cutting of greens before taking seeds where as the crop plants were cut once and twice in contrast to those left as such naturally for seed production. The effect of cutting management to the extent of one cuttings (one at 20 days) was found quite beneficial in comparison to that of control and two cuttings taken for greens before taking seeds on various aspects of studies pertaining to growth, yield and its attributes, quality, uptake of nutrients and net profit.
An examination of data revealed that crop stand and attainment in crop growth as checked by number of green leaves, branches, fresh and dry weight of plant biomass at various successive stages of crop growth as well as at harvest were considerably improved with one cutting treatment over no cutting and two cuttings management. On contrary to plant height and length of longest branches per plant being noticed higher with treatment of no cutting management.

Ascertained to data on root studies viz., no. of nodules per plant and dry weight of roots including nodules inferred that significant improvement in root attributes was attained with no cutting management over one cutting management and two cutting managements, whereas remaining on par with regards to length of primary root (cm) over one cutting management.

The highest yield of greens was recorded with two cuttings treatments over one cutting treatment at first cutting stage, while remaining on par at second cutting stages. Although, maximum drymatter content % in greens was noted at second cutting stage with two cutting treatments in comparison of first cutting stages.
The utility and importance of cutting management is further elucidated that when the yield accelerating attributes are taken into consideration. Though on contrary unlike to growth measurements, delay in flowering, pod formation and physiological maturity of the crop with every increase in the number of cuttings from no cutting to one cutting and one cutting to two cuttings. Mean while, the plants did not cut for greens and left as such stimulate earliness into flowering behaviour, thus early pod formation is concerned, whereas early physiological maturity of the crop was critically examined.

5.3. **YIELD**

Yield of seed and stover being the major economic characteristics, need special consideration, while evaluating the treatment effects.

The yield of any crop is generally based on two chief components viz., yield per plant and plant population per unit area. Further, the yield per plant is governed by various yield contributing characters such as no. of pods per plant, weight of pods per plant, no. of seeds per pod, seed weight per pod, weight of seed per plant, pod length (cm), seed and stover yield (q/ha). An attempt has, therefore, been made in the succeeding paragraphs to establish relationship among yield and yield contributing characters as
influenced by nitrogen and phosphorus application under various cutting management.

5.3.1. **Nitrogen**:

It may be restated that while reviewing the manurial work done already done, it was postulated that the crop of fenugreek did not require much of nitrogen. It is well established fact that most part of nitrogen needed by the crop is met out through the symbiotic process, the extent of which depends on the conditions conducive for development of nodules on the roots, one of the condition may be that in the initial stages, when nodules are not formed on the roots, some starter dose of nitrogen be supplied for better and quick establishment of roots.

With keeping this point in the mind, in the present study, a starter dose was assessed by comparing it with inoculation alone, and with inoculation when used in combination with 25 kg N/ha. An examination of the results evinced that while the plant population remained unchanged due to nitrogenous treatments, the per plant yield was significantly affected. With inoculation alone per plant yield was significantly improved over control. The inoculation alone also noted superior to 25 kg N/ha alone but interesting enough when inoculation was combined with the
starter dose of 25 kg N/ha, the per plant yield was remarkably affected and significantly superseded over control, inoculation alone and 25 kg N/ha showing thereby that inoculation is beneficial and to get the best yield results it should be used alongwith the starter dose. It may be recalled that the root development, nodule formation shoot growth and dry matter accumulation in plant parts were all significantly improved with the treatment of inoculation and that the best results in these growth measurements were obtained where inoculation was done along with starter dose of 25 kg N/ha. Thus, the yield per plant which, undoubtedly, is the reflection of the growth manifestation recorded in the present study can be correlated positively with the changes brought about in growth measurements due to nitrogenous treatments.

The importance and utility of starter dose of nitrogen applied along with the treatment of inoculation are further elucidated where the yield attributing characters are taken into consideration. It may be seen that like growth measurements the number of pods per plant, weight of seeds and pods per plant, no. of seeds and weight per pod, pod length (cm), seed and stover yield (q/ha) were improved when the starter dose of nitrogen along with inoculation was used. Additionally, it may also be pointed out that with seed inoculation + 25kg N/ha, which in turn, might have favoured
the size and weight of seed. Another point of interest worth considering in this respect seems to be the uptake of nitrogen and phosphorus which was stimulated to be the highest where treatment of seed inoculation + 25 kg N/ha was used. Thus, as expected, nature of variations in yield and its attributes were more or less identical to that observed in case of growth and developmental characters.

Further, critical examination of the data (Table 31) makes it clear that seed yield per hectare was increased by 45.38, 18.74 and 49.4 per cent under inoculation alone, 25 kg N/ha and inoculation + 25 kg N/ha, respectively over control. Undoubtedly from these data superiority of inoculation + 25 kg N/ha over seed inoculation alone and 25 kg N/ha used as starter dose alone is well established. It also becomes reasonably clear that either the starter dose of nitrogen alone or the treatment of inoculation alone is not enough but to get a good harvest of the fenugreek crop, seeds should be inoculated with the rhizobium culture and that the starter dose of 25 kg N/ha be used with advantage.

Since plants attained maximum height and produced highest no. of branches, green leaves and drymatter accumulation per plant under the treatment of inoculation + 25 kg N/ha as starter dose, the stover yield was also highest with this treatment combination. Obviously both from seed
and stover production point of view, inoculation of seeds and use of starter dose of nitrogen are considered essential.

In terms of monetary returns also, the maximum profit (Rs. 22617.78) was obtained with the treatment seed inoculation + 25 kg N/ha. Thus, taking all aspects of growth, yield and monetary returns into consideration, inoculation and use of 25 kg N/ha at sowing as starter dose should form the integral part of package of practice for the cultivation of fenugreek.

5.3.2. Phosphorus:

As stated earlier, seed and stover yields are the two most economic aspects of any crop. In a study like this, due consideration of the nature and extent of the effect of phosphorus fertilization on seed yield and factors contributing to it, such as number and weight of pods/plant, pod length, number and weight of seed per pod, seed and stover weight per plant, per plot and quintal per hectare are the great importance. It may be seen that, in general, with every increase in the level of phosphorus, there was an appreciable improvement in all the attributes mentioned above. Similar advantageous effect of increasing levels of phosphorus application to fenugreek crop have also been observed by Tomer and Singh (1975); Raut and Ali (1980 and Gill and Singh (1981), Baboo (1982); Baboo et al., 1992 and Singh and Singh (1989).
Further examination of results (Table 31) indicates that, as expected phosphorus dose produced significant improvement in seed yield. The production of seed per hectare was increased by 25.49 and 49.27 per cent with treatment 40 and 80 kg P₂O₅/ha over control. Thus, of course it is evinced that phosphorus dose 80 kg per hectare, increase in seed yield was more pronounced.

Like seed yield, stover yield was also influenced with the increasing levels of phosphorus and as expected here to the best results were observed at 80 kg rate of phosphorus. It may be pointed out that the soils, in which the present experiment was conducted during both the years, were medium in phosphorus content and, therefore, to get this type of response of phosphorus was possible. Not only the growth and yield but the quality of produce as checked by protein content, was improved considerably where higher dose of phosphorus (80 kg) was applied. From these growth, yield and quality data it is quite logical and justifiable to inferred that under the prevailing conditions at Lakhaoiti, 80 kg rate of phosphorus should be regarded as suitable to obtained the best results. These phosphorus results are in close conformity with those reported by Jain et al. (1979), Menon (1973), Manikar and Singh (1974), Tomer and Singh (1975), Singh et al. (1978), Chauhan and Bajpai (1979), Tripathi (1979), Raut and Ali (1980), Taneja et al. (1981),
Gill and Singh (1981), Bhardwaj et al. (1982), Baboo (1982) and Baboo et al. (1992).

In these investigation, the superiority of inoculation with 25 kg N/ha, and 80 kg rate of phosphorus is further well elucidated when their interaction effect is given due consideration. It may be seen that, on the whole, the yield results were highly encouraging being maximum, with this combination, and hence seed inoculation + 25 kg N/ha and use of 80 kg P₂O₅/ha should form a sound fertilizer package of practice for obtaining a good harvest of fenugreek crop. The highest monetary net return as Rs. 24142.00/ha was recorded with the use of 80 kg P₂O₅/ha, while it was Rs. 15604.75 and 20029.38 with 0 and 40 kg P₂O₅/ha. The similar results were reported by Singh and Singh (1989) and Baboo et al. (1992).

5.3.3. Cutting Management:

In the present investigation three cutting managements viz., no cutting, one cutting and two cuttings, were compared. As the cutting number increased from no cutting to one cutting and one cutting to two cutting, the number of branches also increased significantly. The seed yield and stover yield (q/ha) were significantly more with treatment one cuttings management where as the crop was cut once before to seeding over control and two cuttings management.
in respective seasons. However, the yield of greens should be regarded highest with two cuttings management at second cutting stage.

The yield attributes viz., no. and weight of pods and seeds per plant as well as length of pod and seed numbers in individual pod were also considerably improved with one cutting treatment whereas the crop was cut once before taking seed. The superiority of one cutting treatments over no cutting and two cutting treatments was also noted in significant order. Due to the above facts keeping in consideration the higher seed and stover production was recorded with one cutting treatments. In terms of monetary returns, the maximum profit Rs.23258.25 was noted with one cutting treatments.

5.4. QUALITATIVE STUDIES

Quality was judged in the present investigation in terms of protein, nitrogen and phosphorus content in greens, seed and stover as well. The uptake of nitrogen and phosphorys and their concentrations in plants were also taken into consideration in this investigation, while evaluating the treatment effects on quality. All the aspects of quality assessment adopted in this study exhibit that the second season (1993-94), in general, was better than the previous one. It may further be pointed out that test-weight and
viability per cent of seed was also of superior order in the second season (1993-94) as compared to that in 1992-93, while harvest index should also be regarded during second season, though, it was only due to because of suitable environmental conditions which prevailed in that year. The total production of protein of q/ha through seed was higher in 1993-94 as against in 1992-93, obviously the protein content was also recorded slightly higher in second season than previous one.

5.4.1. Nitrogen:

With the treatment of seed inoculation alongwith 25 kg N/ha and seed inoculation alone, the concentration of nitrogen and phosphorus in seed and stover were remarkably improved. Though, the treatment inoculation + 25 kg N/ha and inoculation alone were statistically noted at par with nitrogen content % in stover, protein content and phosphorus content % in both seed and stover during both the years. Consequently, quality of greens in terms of crude fibre, protein, nitrogen and phosphorus content % was also improved with inoculation + 25 kg N/ha. Obviously its superiority to be noted significant in case of crude fibre content per cent at both the cutting stages with treatment inoculation alone, 25 kg N/ha and control, while it was noted on par with regards to nitrogen content at second cutting.
stage and protein and phosphorus content per cent at both the cutting stages during both the seasons. The similar results were observed with nitrogen and phosphorus uptake (kg/ha) through greens.

Moreover, uptake of nitrogen and phosphorus through seed, stover and total produce was also increased due to inoculation alone and inoculation + 25 kg N/ha, but application of 25 kg N/ha alone did not bring any additional improvement in uptake of nitrogen and phosphorus. Here again, the superiority and beneficial effects of seed inoculation + application of 25 kg N/ha, were well marked and that too may be attributed to the improvement brought about by this treatment combination in the size of individual nodule and rate of nodulation on roots as discussed earlier.

Nitrogen being the main constituent of protein is known to affect the quality of seed and stover. Into the present experiment, as expected, the protein content in seed, stover and total production of protein on hectare basis were improved with the treatment of inoculation + 25 kg N/ha. The application of 25 kg N/ha alone was not so effective in this respect also. It may be restated that the uptake and content of nitrogen were both increased with the treatment of seed inoculation + 25 kg N/ha, which play very key role in increasing the protein content. According
to Tripathi and Edward (1978) and Reddy et al. (1978), inoculation + 25 kg N/ha increased nitrogen content in seed over both no inoculation or application of 25 kg N/ha used in isolation. The results of the present investigation are, thus, in close agreement with the findings of these workers.

The residual content of nitrogen, phosphorus and potash in soil was also comparatively more with inoculation + 25 kg N/ha. It is quite apparent that better crop performance at inoculation + 25 kg N/ha led to more left over of N, P and K in the soil because of abundant supply of nitrogen through nitrifying bacteria. It is usually clear that if one element is sufficient in amount, other elements are not needed much by the crop plants hence managing more residual content of the elements.

5.4.2. Phosphorus:

Phosphorus levels also affected the quality of produce. It may be inferred that lower doses of phosphorus viz., 0 and 40 kg/ha did not contribute much in improving the quality, but the improvement brought about by 80 kg rate was quite appreciable and of significant order with this highest rate (80 kg/ha $P_2O_5$), the content of nitrogen and phosphorus, in turn, protein percentage and uptake of nitrogen and phosphorus were all significantly augmented.
Like phosphorus doses, the crude fibre, nitrogen, phosphorus and protein contents in greens as well as uptake of 'N' and 'P' by greens were favourably influenced by the application of phosphorus at varied rates over control. However, the best results with regards to these studies seemed to accrue with 80 kg P$_2$O$_5$/ha. On the other hand, crude fibre content in greens got increased with every increase in the level of phosphorus. Hence the maximum percentage of crude fibre was noted with 80 kg P$_2$O$_5$/ha in this experiment. Thus the pattern of response of phosphorus fertilization in the matter of protein content was similar to that of phosphorus concentration in seed as well as in greens resulting in more uptake of nitrogen and phosphorus by them. Obviously crude fibre content in greens was recorded more with higher rates of phosphorus application which might be due to more lignification and suberization of tissues of the crop plants as phosphorus increases hardiness in them on account of its characteristics.

The phosphate application at higher rates also improved the test weight of seed, viability of seed, 'N' and 'P' content in seed and uptake of 'N' and 'P' by the crop which were superseded remarkably by phosphate fertilization upto 80 kg P$_2$O$_5$/ha. Consequently, higher phosphorus
rates over control possed significant superiority because of due to better performance of crop plants in the present investigation.

Though residual effect on soil fertility was recorded that higher rate of phosphorus doses, more was the left over of N, P and K content in the soil. Hence, the highest left over of these elements was recorded with the greatest rate of phosphorus application in this investigation which was likely to occur due to the presence of phosphorus in soil through fertilizer in sufficient. This led to higher left over of N, P and K in the soil.

It may be restated that with the application of phosphorus, particularly at higher rate, all the growth and yield attributes, as discussed earlier, were favourably improved and hence the quality assessment could also be of superior order with this dose of phosphorus. Malik et al. (1981) also reported that levels of phosphorus yielded significantly higher protein production per hectare over control.

5.4.3. Cutting Management:

With respect to effect of cutting management on quality, it was noted that test weight of seed, N, P and protein content in seed were also significantly improved with the crop cut once before seeding over no cutting and
two cutting treatment. The similar pattern of results was recorded with protein production 'N' and 'P' uptake through seed, stover and total produces, respectively. However, viability per cent of seed to be noted higher with no cutting management.

On the other hand treatment two cutting should be regarded to produced superior crude fibre, 'N', 'P' and protein content per cent in greens at first and second cutting stages. It is quite obvious that higher 'N' and 'P' uptake by the greens were observed at two cutting treatments. Extent, the analysis of soil samples soon after the harvest of the crop. It was recorded that highest left over of 'N', 'P' and 'K' was noted with two cutting treatments, however, phosphorus and potassium content per cent in the soil was noticed almost similar amongst no cutting and one cutting treatments during both the seasons.

In contrast to cutting management highest net monetary return Rs. 23258.25 was gained with one cutting treatments.