## RESULTS AND DISCUSSION

### I. PLANT HEIGHT

Effect of phosphorus fertilizer rates:

The averages plant height, in cm., at the three cuttings are shown in table 34 for 1977/1978 and 1978/1979 seasons.

At the first cutting in 1977/1978 season, the averages of plant height due to of phosphorus fertilizer rates differed significantly from each other at 5% level of significance. The averages of plant height were 45.2 , 44.9 and 42.3 cm., obtained from Zero, 16 and 32 $P_2O_5$ Kg/Fad. treatments, respectively. It is clear that the control treatment gave the tallest plants as compared with the other fertilized plots in first cutting, because the phosphorus fertilizers was not available in soil due to time shortage.

In 1978/1979 season, the differences between the averages plant height due to phosphorus fertilizer rates were significant. The averages values of the first cutting were 41.3, 58.8 and 58.6 cm. For the treatments equal to 0, 16 and 32 $P_2O_5$Kg/Fad., respectively. It was evident that 16 $P_2O_5$Kg/Fad. gave the tallest plants. Also, the over all averages of plant height reached its maximum when received 16 $P_2O_5$Kg/Fad.

At second cutting in 1977/1978 season, the plant height values were 60.9, 80.4 and 78.2 cm. For the treatment of 0, 16 and 32 $P_2O_5$ Kg/Fad., respectively. It was evident that

the application of 16 $P_2O_5$ Kg/Fad. at 2 nd cutting in 1977/78 gave the tallest plant. In 1978/1979 season, the differences between plant height values due to the phosphorus fertilizer rates were increased significantly. The treatment received 32 $P_2O_5$ Kg/Fad. gave the tallest plant.

The average values were 44.8 , 73.9 and 90.7 cm. for 0, 16 and 32 $P_2O_5$Kg/Fad.treatments, respectively. Over all average of plant height in the second cutting significantly affected due to the phosphorus fertilizer rates.

Application of 32 $P_2O_5$ Kg/Fad. gave the maximum average plant height at the second cutting. At the third cutting in 1977/1978 season plant height values differed significantly from each other at 1% level of significance due to the phosphorus fertilizer rates. The averages were 40.1, 64.9 and 63.2 cm. For 0,16 and 32 $P_2O_5$ Kg/Fad. treatments, respectively. It is clear that application of 16 $P_2O_5$ Kg/ Fad. gave the tallest plants. Also, in 1978/79 season the differences between plant height values were highly significant.

The averages of the two seasons in 3 rd cutting were 36.2, 86.8 and 80.2 cm.for 0, 16 and 32 $P_2O_5$ Kg/Fad.treatments, respectively. It is clear that 16 $P_2O_5$ Kg/Fad. gave the tallest plants at the third cutting. The over all averages of the third cutting insure that 16 $P_2O_5$ Kg/Fad. gave the tallest plants. This increase probaply due to the

activity of meristimatic tissues. Therefore the increase in the plant height by phosphorus application is due to the phosphorus role in cell formation, maturation and elongation of the plant.

These results agree with those obtained by Brown(1959) Nossaman and Travis(1966), Kandil (1974), Bashbishy(1975), Hefni and Zeidan(1977), and Hefni et al (1978).

On the other hand,the result obtained by Singh (1973) differ from that obtained in the present investigation because the soil was more richer in organic matter.

Effect of phosphorus application time:

Regarding to the time of phosphorus fertilizer application which is illustrated in table (35), it is clear in 1977/1978 season that plant height values differed significantly from each other due to the time of phosphorus application.

Addition of all amount of phosphorus fertilizer before sowing time gave the tallest plant as compared with the other treatments, while addition the half amount before sowing and the rest before the third cutting gave the shortest plant.

In 1978/1979 season, the averages of plant height were influenced significantly by the time of phosphorus application addition of half amount before the second cutting and the rest before the third cutting gave the highest plant height.

Cutting 2 with respect to application time of phorphorus in 1977/1978 season, it is clear that the time of application had a significant effect on average plant height. The tallest plants were obtained when applied the half amount before sowing and the rest before the third cutting. In 1978/1979 season time of application treatments differed significantly from each other in the average plant height.

Addition of all amount before sowing gave the tallest plant due to the application time of phosphorus in 1977/1978 season. It is clear that time of application had highly significant effect on the average plant height in the third cutting. The averages were 43.8 , 50.9 , 55.7 , 59.9, 63.3 and 62.9cm. for $b_1$ , $b_2$ , $b_3$, $b_4$, $b_5$ and $b_6$ treatments, respectively. It is clear that addition of phosphorus in two portions, half the amount before sowing and the rest before the third cutting gave the tallest plants.

The third cutting in 1978/1979 season, shows highly significant differences between the averages plant height due to the application time of phosphorus fertilizer. The averages were 58.2, 62.5, 65.3, 68.6, 75.4 and 67.7 cm. For the same respective treatments.

It is clear that applying phosphorus at two portions, half the amount before sowing and the rest before the third cutting gave the highest plant height. Also, the over all averages gave the same trend ensuring that $b_5$ treatment gave the tallest plants in the third cutting.

The plant height was affected significantly by phosphorus application time. In the 1 st cutting the plant height increased significantly due to treatments in which phosphate was applied in great amounts before the first cutting. This increase was adversely proportional with the time between phosphorus application and the 1 st cutting and was inversely proportional with the amount of phosphate applied. Therefore, the treatment $b_1$ in which all the amount of phosphate was applied before planting gave the highest increase in the plant height. Then came treatment $b_2$ in which all the amount of phosphate was applied before the 2 nd irrigation, followed by the treatment $b_3$ in which the same amount of phosphate was applied before the 2 nd irrigation. Came next the treatment $b_4$ in which half the amount of phosphate before sowing time and the rest was applied before the second cutting. The difference between the treatments $b_5$ and $b_6$ was not significant when phosphate was applied in great amount before planting and helps in increasing the available phosphorus and therefore the plant's benifit is great and the plant growth and elongation increased due to the important role played by phosphorus in the process of plant growth which increased due to the important role played by phosphorus. The plants to which great amounts of phosphates were applied before planting gave tallest plants than those to which half the amount of phosphate, was applied before sowing or to which the phosphate, was applied lately.

In the 2 nd cutting the treatment $b_1$ was the most prevelant, then treatment $b_4$ then $b_5$. The difference between $b_4$ and $b_5$ was not significant. The increase in the plant height due to $b_1$ treatment resulted from continuous effect of phosphate application. Regard to the treatment $b_4$, the increase in the plant height was due to the application of whole amount of phosphate before the 2 nd cutting which leading to increase the available phosphorus during growing.

In the 3 rd cutting the effect of phosphate application times was opposite especially in the 1 st cutting. The plant height in the treatments in which superphosphate was applied in late times was greater than that in the treatments in which superphosphate was applied in the early times and therefore the treatments $b_6$ , $b_5$ and $b_4$ were more prevalant than treatments $b_1$, $b_2$ and $b_3$, because the part of phosphorus which was applied in early times was fixed in the soil and the available part was consumed by the plants in the 1 st and 2 nd cuttings and what remained for the plants in the 3 rd cutting was not sufficient.

On the other hand, when phosphorus was applied in late times the available part was great and therefore the chance for the plant to grow and elongate is great. Generally it could be concluded that addition of phosphorus fertilizer at the rate of 16 $P_2O_5$ Kg/ Fad.before sowing, gave a maximum average plant height at the first cutting. Also, addition

of 16 or 32 $P_2O_5$ Kg/Fad. at post stages of plant growth increased the average plant height in the second and third cuttings. These results agree with that obtained by El-Bashbishy (1976).

Effect of the interaction between phosphorus fertilizer rates and application time of phosphorus:

The averages values of plant height due to the interaction between phosphorus fertilizer rates and application time of phosphorus show in table 36 the interaction between phosphorus fertilizer rates and their application times in the 3 rd cutting showed that the rate 16 $P_2O_5$ Kg/Fad. applied on two parts ; the half amount was applied before planting and the rest was applied before the third cutting led to significant increase in the plant height. The application of 32 $P_2O_5$ Kg/Fad. on two parts: the 1 st before the second cutting and the rest before the third cutting led also to the same trend, as compared with the other treatments. This was due to the application of phosphorus in two parts helps in supplying the available phosphorus in sufficient amounts in relatively long periods.

Average Values of plant height, in cm., as affected by phosphorus fertilizer rates (Table34), phosphorus application time(Table35) and the interaction between them (Table 36).

Table 34:

| cutting number | season | $P_2O_5$ Kg/Fad. | | | L.S.D | |
|---|---|---|---|---|---|---|
| | | 0 | I6 | 3[illegible] | I% | 5% |
| CUT.I | I977/78 | 45.2 | 44.9 | 42.3 | I.0 | 0.7 |
| | I978/79 | 4I.3 | 58.8 | 58.6 | I.4 | I.0 |
| | Combined | 43.2 | 5I.9 | 50.5 | 0.7 | 0.5 |
| out.2 | I977/78 | 60.9 | 80.4 | 78.2 | I.5 | I.0 |
| | I978/79 | 44.8 | 73.9 | 90.7 | 0.9 | 0.6 |
| | Combined | 52.9 | 77.2 | 84.5 | 3.0 | 2.3 |
| out.3 | I977/78 | 40.I | 64.9 | 63.2 | I.5 | 0.8 |
| | I978/79 | 36.2 | 86.8 | 80.2 | 0.9 | 0.7 |
| | Combined | 38.2 | 75.9 | 7I.7 | 2.3 | 2.0 |

Table 35:

| cutting number | season | phosphorus application times | | | | | | L.S.D | |
|---|---|---|---|---|---|---|---|---|---|
| | | $b_I$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | I% | 5% |
| out.I | I977/78 | 47.4 | 44.8 | 46.5 | 43.7 | 39.I | 43.5 | 0.8 | I.4 |
| | I978/79 | 47.5 | 50.5 | 56.5 | 5I.6 | 53.[illegible] | 57.2 | I.5 | I.2 |
| | Combined | 47.5 | 47.7 | 5I.5 | 47.6 | 46.5 | 50.[illegible] | I.2 | 0.9 |
| CUT.2 | I977/78 | 78.0 | 70.9 | 63.3 | 79.4 | 79.5 | 68.0 | I.6 | I.2 |
| | I978/79 | 76.3 | 68.5 | 67.4 | 69.6 | 70.9 | 66.I | 0.9 | 0.7 |
| | Combined | 77.I | 69.7 | 65.4 | 74.5 | 75.2 | 67.I | I.I | 0.8 |
| out.3 | I977/78 | 43.8 | 50.9 | 55.7 | 59.9 | 63.3 | 62.9 | 2.4 | I.6 |
| | I978/79 | 58.2 | 62.5 | 65.3 | 68.6 | 57.4 | 67.7 | I.7 | I.3 |
| | Combined | 5I.0 | 56.7 | 60.5 | 64.3 | 69.4 | 65.3 | 3.2 | 2.8 |

Table 36:

| $P_2O_5$ Kg/Fad. | Phosphorus application times | | | | | | L.S.D | |
|---|---|---|---|---|---|---|---|---|
| | $b_I$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | I% | 5% |
| 0 | 38.3 | 38.8 | 39.4 | 37.2 | 26.8 | 29.5 | 4.6 | 2.6 |
| I6 | 62.6 | 69.3 | 73.3 | 77.9 | 88.4 | 83.6 | | |
| 32 | 52.7 | 62.0 | 68.9 | 77.7 | 8I.8 | 88.4 | | |

## 2. LEAVES /PLANT RATIO

Effect of phosphorus fertilizer rates:

Table 37 : shows the averages of leaves / plant ratio as affected by phosphorus fertilizer rates in 1978/79 season. In the first cutting of 1978/79 season, the average leaves/ plant ratio gave a highly significant increase due to the phosphorus fertilizer rates. The averages were 16.4%, 20.3% and 18.3% for 0,16 and 32 $P_2O_5$ Kg/Fad.treatments, respectively. It is clear that the maximum ratio was obtained from 16 $P_2O_5$ Kg/Fad. treatment.

In the second cutting the average leaves/ plant ratio was affected significantly due to the phosphorus fertilizer rates. The averages were 27.8, 33.8 percent for 0 , 16 and 32 $P_2O_5$ Kg/ Fad. respectively.

In the third cutting leaves/ plant ratio values increased significantly due to the phosphorus fertilizer rates. The averages were 24.2% , 33.3% and 27.2% for the rates of 0, 16 and 32 $P_2O_5$ Kg/Fad., respectively. The maximum percentage was obtained when 16 $P_2O_5$ Kg/Fad. treatment was applied.

Application of phosphate led to an increase in leaves/ plant ratio apparently in the 1 st , 2 nd and 3 rd cuttings. These results agree with phosphate role in the plant as it shares in respiration, nitrogen metabolism and formation of

proteins which in turn helps the plant growth and this induce an increase in the number of leaves and their surface due to the nutrient elements and energy production.

These results agree with that obtained by Abdel-Gawad et al and disagree with those obtained by Singh (1973) and Kandil (1974) because the soil was rich in organic matter.

Effect of phosphorus application time:

Table 38 :shows the average leaves / plant ratio as affected by phosphorus application time in 1978/1979 season. In the first cutting, the leaves/ plant ratio averages were influenced significantly by phosphorus application time. The averages were 19.6 , 19.1 , 20.5 , 17.7 , 16.6 and 17.2 for $b_1$, $b_2$, $b_3$ , $b_4$ , $b_5$ , and $b_6$ treatments, respectively . Application of all amount of phosphorus before the 2 nd irrigation ( $b_3$) gave the highest leaves/ plant ratio. The differences between the averages leaves/ plant ratio were highly significant due to the time of application.

The averages were 33.9 , 33.2 , 30.7 , 33.2 , 36.5 and 30.2 for $b_1$ , $b_2$ , $b_3$ , $b_4$ , $b_5$ and $b_6$ treatments , respectively.

With respect to time of application, differences between leaves/ plant ratio values were highly significant. The averages were 25.5 , 26.5, 29.8 , 28.5, 29.9 and 29.2 percent for $b_1$ , $b_2$, $b_3$, $b_4$, $b_5$ and $b_6$ treatments, respectively.

It is clear that the addition of half amount of phosphorus before sowing and the rest before the third cutting gave a maximum average of leaves/ plant ratio.

The phosphate application time had different effects on leaves/ plant ratio. The effect was most evident in the treatments in which all the amount of phosphate was applied before the 1 st cutting such treatments $b_1$, $b_2$ and $b_3$. Ranked the second the treatments in which half the amount of phosphate was applied before the 1 st cutting or phosphate was not applied before the 1 st cutting such treatment $b_4$, $b_5$ and $b_6$.

This is due to the importance of phosphate supplied during early plant growth , because it helps root growth and also helps the absorption of water and nutrient elements and hence of a good vegetative collection is formed. The plants at which no phosphate was applied before the 1 st cutting or small amount of phosphate was applied more weak due to the small leaves and a small leaves / plant ratio.

This increase in the leaves/ plant ratio in the treatment $b_3$ i.e. addition of all the amount of phosphate before the 2 nd irrigation , was greater than those in treatments $b_1$ and $b_2$ due to the application of phosphate during the maximum growth period of plants.

In the 3 rd cutting, treatments $b_3$, $b_4$ and $b_6$ gave a greater leaves / plant ratio in comparison with the treatments

$b_1$ and $b_2$ , because the amount of available phosphorus remaining after phosphate application at earlier time either before planting or before the 1 st cutting. These results agree with that obtained by Abdel-Gawad et al(1977).

Effect of the interaction between phosphorus fertiliser rates and application times of phosphorus (AXb)

The average values leaves / plant ratio due to the interaction between phosphorus fertilizer rates and application time of phosphorus are shown in Table 36.

Interaction of phosphate application times with the rate 16 Kg/$P_2O_5$/Fad.gave a greater leaves / plant ratio in comparison with the interaction with the rate of 0 and 32 Kg/ $P_2O_5$/ Fad., because the application of great amount of phosphate might lead to transformation of some nutrient elements in the soil to unsuitable form e.g. zinc and iron and hence helps the formation of iron phosphate and zinc phosphate. These compounds are not disolved and the plant suffer from shortage of zinc and iron especially the leaves beeause iron is an important element in the formation of chlorophyll which plays an important role in the process of photosynthesis and this effect leaves formation and growth.

The 16 $P_2O_5$ Kg/Fad.rate is more suitable for the plant needs and availability of nutrient elements in the soil which led to the increase of the efficiency of the plant to form leaves.

The treatment $b_3$( application of the whole phosphorus amount before the second irrigation) with the rate of 16 $P_2O_5$ Kg/Fad.gave the highest leaves/ plant ratio in comparison with the other treatments .

Average values leaves/plant ratio as affected by phosphours fertilizer rates (Table 37), phosphorus application time (Table 38) and the interaction between them (Table 39).

Table 37:

| cutting | season | $P_2O_5$ Kg/Fad. | | | L.S.D. | |
|---|---|---|---|---|---|---|
| | | 0 | 16 | 32 | 1% | 5% |
| Cut. 1 | 1978/79 | 16.4 | 20.3 | 18.8 | 0.7 | 0.5 |
| Cut. 2 | 1978/79 | 27.8 | 33.8 | 37.3 | 0.8 | 0.6 |
| Cut. 3 | 1978/79 | 24.2 | 33.2 | 27.2 | 1.6 | 1.3 |

Table 38

| Cutting | Season | Phosphours application times | | | | | | L.S.D. | |
|---|---|---|---|---|---|---|---|---|---|
| | | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | 1% | 5% |
| Cut. 1 | 1978/79 | 19.6 | 19.1 | 20.5 | 17.7 | 16.6 | 17.2 | 0.8 | 0.6 |
| Cut. 2 | 1978/79 | 33.9 | 33.2 | 30.7 | 33.2 | 36.5 | 30.2 | 0.7 | 0.5 |
| Cut. 3 | 1978/79 | 25.5 | 26.5 | 29.8 | 28.5 | 29.9 | 29.2 | 1.1 | 0.9 |

Table 39

| $P_2O_5$ Kg/Fad. | Phosphorus application times | | | | | | L.S.D. | |
|---|---|---|---|---|---|---|---|---|
| | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | 1% | 5% |
| 0 | 24.3 | 23.5 | 26.5 | 24.6 | 23.4 | 22.8 | 1.7 | 0.9 |
| 16 | 28.7 | 33.4 | 36.1 | 33.1 | 33.8 | 34.7 | | |
| 32 | 23.6 | 22.5 | 26.8 | 27.8 | 32.7 | 30.0 | | |

## 3. NUMBER OF TILLERS PER PLANT

Effect of phosphorus fertilizer rates:

The averages number of tillers per plant in the three cuttings are shown in table (40) for 1977/1978 and 1978/1979 seasons.

In the first cutting in 1977/1978 season the average number of tillers/plant increased significantly at 1% level as affected by phosphorus fertilizer rates. The averages were 1.20, 1.35 and 1.08 tillers/plant for 0, 16 and $P_2O_5$ Kg/ Fad., respectively. It is clear that 16 $P_2O_5$ Kg/Fad.gave a maximum value. In 1978/1979 the averages were 1.22,1.33 and 1.20 tillers per plant for the some respective treatments.

The difference between the over all averages of both years was significantly affected due to the phosphorus fertilizer rates. Applying 16 $P_2O_5$ Kg/Fad. treatments gave the maximum number of tillers/ plant.

In the second cutting during two seasons, the difference between the averages number of tillers/ plant was significantly affected due to the phosphorus fertilizer rates.

In 1977/1978 , the averages were 1.96 , 2.96 and 3.07 tillers per plant for 0, 16 and 32 $P_2O_5$ Kg/Fad. treatments, respectively. In 1978/1979 season, the averages were 1.86, 3.44 and 2.8 tillers / plant for the same respective treatments.

Also, the average of tillers / plant of the two seasons show that 16 $P_2O_5$ Kg/Fad.treatment gave the highest value.

In the third cutting of 1977/1978 and 1978/ 1979 seasons , the averages number of tillers/ plant were significantly affected by phosphorus fertilizer rates. In 1977/78 applying 0 , 16 and 32 $P_2O_5$ Kg/Fad.gave 2.17 , 4.41 and 3.48 tillers / plant, respectively.

In 1978/1979 , the averages were 2.42 , 3.96 and 3.23 tillers / plant for 0, 16 and 32 $P_2O_5$ Kg/Fad.,respectively. The over all averages of both seasons revealing that 16 $P_2O_5$/ Kg/Fad. treatment gave a maximum number of tillers / plant in the third cutting.

Phosphorus has a role in transformation of carbohydrate to simple nutrient elements including the phosphorus compounds. All these functions have a direct relationship with new tillers formation in the plant which need cell division and transformation of nutrient elements and therefore phosphorus fertilization has a great effect on the number of tillers/ plant.

The increase of tillers/ plant due to the addition of 16 $P_2O_5$ Kg/Fad.rate was higher than that obtained from 32 $P_2O_5$ Kg/Fad.rate in the 1 st and 2 nd cuttings, whereas significant differences was obtained in the 3 rd cutting.

These results agree with those obtained by Kandil (1973), Singh (1975) , Abdel-Gawad et al (1977) and Hefni and Zeidan (1977).

Effect of phosphorus application time :

The average number of tillers per plant at the three cuttings is shown in Table (41) for 1977/78 , and 1978/79 seasons.

In cutting 1, the average of the two years shows that the treatments to which all the amount of phosphorus was added before the 1 st cutting i.e. (treatments $b_1$), gave a highest number of tillers/ plant more than that obtained from the treatments to which half the amount of phosphate was applied before the 1 st cutting or to which no phosphate was applied during this period e.e. It was observed that the number of tillers per plant was adversely proportional with the time between phosphate application and the 1 st cutting. Treatment $b_1$ gave the highest number of tillers per plant followed by the treatment $b_2$ which was applied before the 1 st irrigation.

In cutting 2. the average of the two seasons indicate that the treatment , $b_1$ gave a significant increase of tillering over that obtained when half amount before planting and the rest before the third cutting.
Treatment $b_4$ in 1977/1978 and $b_5$ in 1978/1979 ranked the second , to which half the amount of phosphate was applied before planting and the rest before the second cutting, the treatments in which phosphate was applied before planting and therefore the benifit of the plant was great and lead to active

formation of new tillers due to the importance of phosphorus in the division of meristematic cells which encourage the formation of the tillers.

In cutting 3. shows that the treatment $b_6$ to which half the amount of phosphrus was applied before the second cutting and the rest before the third cutting gave a highly significant tillering rate followed by treatment $b_5$. It was noted that the number of tillers per plant was less whenever the time between phosphorus application and 3 rd cutting was great and therefore treatment $b_6$ gave the highest average in the number of tillers/ plant. The least effect was obtained by the treatment $b_1$ to which phosphorus was applied before planting because the benifit from phosphorus in the soil decreased by time as a great part of phosphorus was fixed in the soil and became unsuitable for absorption. This effect was reflected upon the physiological activity of the plant which encourage the formation of tillers.

The treatments to which phosphorus was applied before the third cutting i.e. ( $b_5$ and $b_6$) gave the highest number of tillers/ plant due to the increase in available phosphorus. On the contrary ; the treatments to which phosphate was applied early i.e. ( before planting ) gave the lowest tillering because the plants utilized the available phosphorus during growing before the 1 st and 2 nd cuttings and the rest amount of phosphorus was not sufficient.

Effect of the interaction between phosphorus fertilizer rates and application times of phosphorus:

Table 42: shows the average values of number of tillers per plant as affected by the interaction between the phosphorus fertilizer rates and time of application. In the 3 rd cutting the treatment which received 16 $P_2O_5$ Kg/Fad.(half the amount of phosphorus before the second cutting and the rest before the third cutting) gave the highest tillering rate as compared with the other treatments.

This was followed by treatment $b_5$ in which half the amount of phosphorus was applied before planting and the rest before the third cutting because application of 16 $P_2O_5$ Kg/Fad, rate in two parts supply the active shoots of the plant and encouraged the new tillers formation. When phosphorus was increased to 32 Kg $P_2O_5$/ Fad.rate it may led to a decrease in absorption of another nutrient elements and hence affecting the process of tillering. It is clear that 16 Kg $P_2O_5$/Fad. rate considered a suitable, treatment.

: Average Values of number of tillers/Plant as affected by phosphorus fertilizer rates (Table 40), phosphorus application time (Table 4I), and the interaction between them (Table 42).

Table 40:

| cutting | season | $P_2O_5$ Kg/fad. 0 | I6 | 32 | L.S.D. I% | 5% |
|---|---|---|---|---|---|---|
| cut.I. | I977/78 | I.20 | I.35 | I.08 | 0.I0 | 0.07 |
| | I978/79 | I.22 | I.33 | I.20 | 0.I0 | 0.07 |
| | Combined | I.2I | I.34 | I.I4 | 0.06 | 0.05 |
| cut.2 | I977/78 | I.96 | 2.96 | 3.07 | 0.I6 | 0.II |
| | I978/79 | I.86 | 3.44 | 2.80 | 0.26 | 0.I8 |
| | Combined | I.9I | 3.30 | 2.94 | 0.23 | 0.I9 |
| cut.3. | I977/78 | 2.I7 | 4.4I | 3.48 | 0.24 | 0.I7 |
| | I978/79 | 2.42 | 3.96 | 3.23 | 0.I4 | 0.I0 |
| | Combined | 2.29 | 4.I9 | 3.36 | 2.64 | I.I5 |

Table 4I:

| cutting | season | Phosphorus application times $b_I$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | L.S. D. 1% | 5% |
|---|---|---|---|---|---|---|---|---|---|
| Cut. I | I977/78 | I.34 | I.3I | I.36 | I.09 | I.09 | I.I3 | 0.II | 0.08 |
| | I978/79 | I.43 | I.33 | I.21 | I.30 | I.13 | I.II | I.II | 0.I2 |
| | Combined | I.38 | I.22 | I.28 | I.9 | I.II | I.I2 | 0.33 | 0.2I |
| Cut.2 | I977/78 | 3.I9 | 2.65 | I.87 | 3.I2 | 2.97 | 2.I5 | 0.2I | 0.I5 |
| | I978/79 | 3.29 | 2.5I | 2.4I | 2.65 | 3.03 | 2.3I | 0.09 | 0.07 |
| | Combined | 3.24 | 2.58 | 2.I4 | 2.89 | 3.00 | 2.23 | 0.I0 | 0.06 |
| Cut.3 | I977/78 | 2.79 | 3.05 | 3.24 | 3.23 | 3.57 | 4.5I | 0.24 | 0.I8 |
| | I978/79 | 2.56 | 2.85 | 2.9I | 3.23 | 3.23 | 3.77 | 3.77 | 0.I7 |
| | Combined | 2.68 | 2.96 | 3.09 | 3.23 | 3.55 | 4.14 | 0.23 | 0.I7 |

Table 42:

| $P_2O_5$ Kg/Fad. | Phosphorus application times $b_2$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | L.S.D. 1% | 5% |
|---|---|---|---|---|---|---|---|---|
| 0 | 2.05 | 2.48 | 2.47 | I.98 | I.95 | 2.76 | 0.27 | 0.I3 |
| I6 | 3.25 | 3.65 | 3.60 | 4.25 | 4.84 | 5.5I | | |
| 32 | 2.73 | 2.74 | 3.I4 | 3.45 | 3.92 | 4.14 | | |

## 4. FRESH WEIGHT PER PLANT

Effect of phosphorus fertilizer rates:

The average values of fresh weight per plant in the three cuttings are presented in (Table 43) for 1977/1978 and 1978/1979 seasons.

At the first cutting in 1977/1978 season, the average values of fresh weight per plant in(gms) increased significantly by different phosphorus fertilizer rates. The averages were 7.04 , 7.23 and 6.38 gm. for 0, 16 and 32 Kg. $P_2O_5$Kg/Fad. treatments, respectively. It is clear that application of 16 $P_2O_5$ Kg/Fad. gave the maximum fresh weight per plant.

In 1978/1979 season, the differences between the averages of fresh weight per plant were significant due to the phosphorus fertilizer rates. The averages were 7.78 , 7.97 and 7,02 gm for the same respective treatments. Also , the over all averages were significantly affected by phosphorus fertilizer rates insuling that, application of 16 $P_2O_5$ Kg/Fad.gave a maximum value.

At the second cutting in 1977/1978 season , the averages values fresh weight per plant were significantly affected at 1% level due to phosphorus fertilizer rate. The averages were 11.42 , 19.31 and 15.50 gm. for 0, 16 and 32 $P_2O_5$ Kg/Fad., respectively.

In 1978/1979 season, the same trend was obtained. The averages were 10.22, 17.79 and 12.08 gm.for the same respective treatments. The averages of both years show that, application of 16 $P_2O_5$ Kg/Fad. gave a maximum fresh weight per plant.

At third cutting in 1977/1978 season, the fresh weight per plant were influenced significantly due to phosphorus fertilizer rates at 1% level of significance. The averages were 10.58, 18.54 and 12.98gm. for 0, 16 and 32 $P_2O_5$Kg/Fad. treatments, respectively. In 1978/ 1979 season the same trend was found. The averages of fresh weight per plant were 9.05 , 22.90 and 17.10 gm.for the same respective treatments. Also, the averages of the two years were significantly affected by phosphorus fertilizer rates which indicate that the application of 16 $P_2O_5$Kg/Fad. maximized the average fresh weight per plant.

Under the circumstances of the Egyptian soil it was evident that nitrogen and phosphorus are a controlling factors in the growth of legume crops such as Egyptian clover. Plants get nitrogen from air through bacteria living on plant roots and fix atmospheric nitrogen to the plant and taking carbohydrate from the plant.

On the other hand, phosphorus plays a role in starch transformation to simple nutrient elements that go the different parts of the plant from which the roots of bacteria

are contained and hence activation of these bacteria in fixation of atmospheric nitrogen which helps plant growth. As well as the phosphorus is considered as a deciding factor in plant growth as phosphorus application which helps plant growth and increases the number of tillers and hence resulted in increasing the plant weight. The 16 $P_2O_5$ Kg/Fad. rate gave the highest fresh weight per plant in all cuttings , the results obtained, showed a decrease in the fresh weight/ plant by adding more than 16 $P_2O_5$ Kg/Fad. rate. Application of higher rates of phosphorus than 16 $P_2O_5$ Kg/Fad.lead to transformation of some important elements to a difficult from which can not be uptaking by plant.

These results agree with those obtained by Brown(1959) and Hefni and Zeidan (1977).

Effect of phosphorus application time:

Cutting.1, Regarding to the phosphorus application time in 1977/1978 season which illestrated in table 44, the results indicate that significant differences between the averages of fresh weight per plant were obtained. The averages were 7.24 , 7.06 , 7.33 , 6.11, 6.57 and 6.99 gm. for $b_1$, $b_2$ $b_3$, $b_4$, $b_5$ and $b_6$, respectively. In 1978/1979 season, there was a significant effect for phosphorus application time on fresh weight per plant values. The averages were 8.39 ,8.18, 8.13 , 7.79 , 6.39 and 6.70 gm. for the same respective treatments mentioned above. It could be concluded that addition of phosphorus in one portion before sowing gave the best result in the first cutting.

Cut.2

With respect to phosphorus application time in 1977/78 season, it is clear that there were highly significant differences between the averages of fresh weight due to the phosphorus application time. The averages were 17.64 , 15.20, 12.18, 18.78, 15.90 and 12.73 gm. for $b_1$, $b_2$, $b_3$, $b_4$, $b_5$ and $b_6$ treatments, respectively.

In 1978/1979 season, the same result was obtained. The averages of fresh weight per plant were 16.52 , 11.59, 10.93, 13.75 , 16.64 and 10.86 gm.for $b_1$, $b_2$, $b_3$, $b_4$, $b_5$, and $b_6$ treatments, respectively. It could be concluded that, addition of phosphorus on two portions, half the amount before sowing and the rest before the second or the third cutting, gave the highest values of fresh weight values of fresh weigh per plant

The fresh weight/ plant was affected significantly due to the phosphorus application time in 1977/1978 and 1978/1979 seasons, as well as the average of two seasons.

Cut.3.

In 1977/1978 the averages were 11.35, 12.44, 13.78, 13.28, 15.17 and 18.11 gm. For $b_1$ , $b_2$ , $b_3$ , $b_4$, $b_5$ and $b_6$ treatments, respectively. In 1978 / 1979 season averages were 14.96, 14.99, 15.50 , 16.13 , 17.48 and 19.10 gm. for the respective treatments mentioned above. It is clear that the addition of phosphorus on two portions, half the amount

before the second cutting and the rest before the third cutting, gave the highest values of fresh weight / plant.

Phosphate application times had a low effect on plant weight in the 1 st cutting. Plant weight for the treatments in which all the amount of phosphate was added before the 1 st cutting was greater than that obtained from the treatments in which half the amount of phosphate was applied or when phosphate was not applied during this period.

In the 2 nd cutting the effect of phosphate application times on the plant weight was evident. Treatment $b_1$ (application of all the amount of phosphate before planting) gave the highest increase in plant weight by a highly significant difference. Treatments $b_4$ and $b_5$ came next in which half the amount of phosphate was applied before planting. These results showed that application of phosphorus before planting significantly affected the plant weight in the 2 nd cutting, because phosphorus increased plant height, and number of tillers/ plant as well as helps the rapid formation of leaves which fix energy and supply nutrient elements that go to the different parts of the plant.

In the 3 rd cutting the plant weight increased significantly at 1% level when received phosphorus before planting or before the first cutting. The results show that the plant weight was adversely proportional to the amount of phosphate, applied and its times of application.

Treatment $b_6$ (half the amount of phosphate was applied before the second cutting and the other half before the third cutting) gave the highest plant weight followed by treatments $b_5$ (half the amount of phosphate was applied before planting and the rest before the third cutting).

Came next the treatment $b_4$ i.e. ( half the amount of phosphate was applied before planting and the rest before the second cutting). Application of all the phosphates before planting, gave the least plant weight in the 3 rd cutting.

Phosphate application lately gave plants a suitable amount of available phosphorus. On the other hand , the available phosphorus which resulted from phosphate application before planting i.e; about 100 days before the 2 nd cutting, was consumed by the plants of the 1 st and 2 nd cuttings and then remained for the plants of the 3 rd cutting insufficient amount of phosphorus for plant growth.

Effect of the interaction between phosphorus fertilizer rates and application times of phosphorus:

Table 45: shows that in the 3 rd cutting. Treatment $b_6$ with 16 Kg $P_2O_5$/Fad. rate gave a highly significant increase in plant weight over those obtained by the other treatments.

The results, obtained have a decreasing tendency inversely proportional with the time lapses between phosphate

application and the time of the 3 rd cutting. In the treatments in which phosphorus was applied lately gave a higher plant weight than those in which phosphate was applied early i.e. before planting or before the 1 st cutting.

This was due to the amount of available phosphate in the soil before the 3 rd cutting. In the treatments in which phosphate was applied lately the amount of available phosphorus was greater than those in which phosphate was applied early.

Average values of fresh weight in gm. per plant, as affected by phosphorus fertilizer rates (table 43), phosphorus application time (table 44), and the interaction between them (table 45).

Table 43:

| Cutting | Season | $P_2O_5$ Kg/ Fad. | | | L.S. D. | |
|---|---|---|---|---|---|---|
| | | 0 | 16 | 32 | 1% | 5% |
| Cut. 1 | 1977/1978 | 7.04 | 7.23 | 6.38 | 0.52 | 0.36 |
| | 1978/1979 | 7.78 | 7.97 | 7.02 | 0.66 | 0.46 |
| | Combined | 7.41 | 7.60 | 6.70 | 0.86 | 0.59 |
| Cut. 2 | 1977/1978 | 11.42 | 19.31 | 15.50 | 0.64 | 0.44 |
| | 1978/1979 | 10.22 | 17.79 | 12.08 | 1.21 | 0.83 |
| | Combined | 10.85 | 18.55 | 13.79 | 3.19 | 2.44 |
| Cut. 3 | 1977/1978 | 10.58 | 18.54 | 12.98 | 0.63 | 0.43 |
| | 1978/1979 | 9.05 | 22.90 | 17.10 | 0.55 | 0.38 |
| | Combined | 9.82 | 20.72 | 15.04 | 0.93 | 0.68 |

Table 44:

| Cutting | Season | Phosphorus application times | | | | | | L.S.D. | |
|---|---|---|---|---|---|---|---|---|---|
| | | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | 1% | 5% |
| Cut. 1 | 1977/1978 | 7.24 | 7.06 | 7.33 | 6.11 | 6.57 | 6.99 | 0.71 | 0.54 |
| | 1978/1979 | 8.39 | 8.18 | 8.13 | 7.79 | 6.38 | 6.70 | 0.85 | 0.64 |
| | Combined | 7.82 | 7.62 | 7.73 | 6.92 | 6.47 | 6.85 | 2.26 | 1.45 |
| Cut. 2 | 1977/1978 | 17.64 | 15.20 | 12.18 | 18.78 | 15.90 | 12.73 | 0.85 | 0.64 |
| | 1978/1979 | 16.52 | 11.59 | 10.83 | 13.75 | 16.64 | 10.86 | 0.81 | 0.61 |
| | Combined | 17.08 | 13.40 | 11.51 | 16.27 | 16.27 | 11.80 | 0.58 | 0.44 |
| Cut. 3 | 1977/1978 | 11.35 | 12.44 | 13.78 | 13.28 | 15.17 | 18.11 | 0.91 | 0.68 |
| | 1978/1979 | 14.96 | 14.99 | 15.50 | 16.13 | 17.48 | 19.10 | 0.83 | 0.63 |
| | Combined | 13.16 | 13.72 | 14.64 | 14.71 | 16.33 | 18.61 | 2.36 | 1.50 |

Table 45:

| $P_2O_5$Kg/ Fad. | Phosphorus application times | | | | | | L.S.D. | |
|---|---|---|---|---|---|---|---|---|
| | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | 1% | 5% |
| 0 | 10.09 | 10.86 | 10.34 | 7.58 | 8.58 | 11.48 | | |
| 16 | 11.94 | 17.20 | 18.44 | 21.51 | 24.56 | 27.68 | 1.34 | 0.62 |
| 32 | 14.49 | 13.09 | 15.14 | 15.04 | 15.82 | 16.66 | | |

## 5. FRESH YIELD

Effect of phosphorus fertilizer rates:(A)

Average fresh yield in tons/Fad. in the three cuttings as well as the total fresh yield of the three cuttings are presented in (Table 46) for 1977/1978 and 1978/1979 seasons.

At the first cutting in 1977/1978 season, the averages of fresh yield per faddan differed significantly from each other when 0, 16 and 32 $P_2O_5$ Kg/Fad. treatments were applied. The averages were 7.643, 13.700, and 13.133 ton/Fad. for 0 , 16 and 32 $P_2O_5$ Kg/Fad., respectively. It is clear that 16 $P_2O_5$ Kg/Fad. gave the best fresh yield. In 1978/1979 season, differences between fresh yield average values were found to be significant due to the phosphorus fertilizer rates.

The averages were 7.790 , 9.373 and 9.030 ton/Fad. for 0, 16 and 32 $P_2O_5$ Kg/Fad.treatments, respectively. The same results were found regarding to the over all average of both seasons.

At the second cutting the averages of fresh yield in both seasons differed significantly from each other due to the phosphorus application time. The average in 1977/1978 season, were 8.177, 11.813 and 10.453 ton/Fad. for 0, 16 and 32 $P_2O_5$ Kg/Fad., respectively. The averages in 1978/ 1979 season were 10.733, 12.307 and 13.427 ton/Fad. for the same

respective treatments. It is clear from these results and the over all average of both seasons that 16 $P_2O_5$ Kg/Fad. gave a maximum fresh yield.

In 1977/1978 and 1978/1979 at the third cutting, the fresh yield influenced significantly due to the phosphorus fertilizer rates. The averages in 1977/1978 were 4.567 , 8.329 and 6.759 ton/Fad. for 0 , 16 and 32 $P_2O_5$Kf/Fad., respectively, The averages in 1978/1979 were 5.290 , 14.513 and 13.776 ton/Fad. for the same respective treatments. These results as well as the over all averages revealed that, application of 16 $P_2O_5$ Kg/Fad. gave the maximum fresh yield.

Phosphorus application led to an increase in the fresh yield/Fad. in the 1 st , 2 nd and 3 rd cuttings. The increase was highly significant in comparison with the control. Legume crops such Egyptian clover can benifit from atmospheric nitrogen through the bacteria living on the roots of these plants and hence fertilization with phosphorus become the deciding factor for production of good crop taking into consideration the availability of other factors. e.g. good soil, suitable atmospheric circumstances and suitable seeds rates.

If fertilization with phosphorus is essential for field crops, it is more essential to legume crops because they contain a high production of phosphorus if compared with other crops e.g. graminea such wheat and corn. The increase

in the fresh yield/ Faddan resulted from the increase in the yield components e.g. plant height, number of tillers plant and plant weight.

Results, obtained showed that phosphorus application had a highly significant effect on plant height, number of tillers/ plant and plant weight and therefore leading to an increase in the fresh yield / Fad. This is due to the important role played by phosphorus in the biological processes in the plant as it is one of the important elements in the cell nucleulus. The phosphorus also enters in the formation of nucleic acid and therefore cell division, which results in increasing plant growth. All these processes are important for plant growth and formation of roots, tillers and leaves. Therefore deficiency of phosphorus during plant growth resulted in the production of short plants with weak leaves and hence a small fresh yield/ Fad.

These results agree with those obtained by Snukla (1957). El-Damaty(1962) ; Templeton(1966) , Jonse et al (1970);Singh (1973) ; Kandil (1974) ; Omar (1974); Banwart (1975) ; and Bashbishi(1976).

Effect of phosphorus application time:

Table 47 : shows the average values of fresh yeidl/Fad. as affected by the phosphorus application time during 1977/78 and 1978/1979 seasons. It is clear that it has a significant effect on the average fresh yield per faddan. In 1977/1978 season, cut.1, the averages were 11.747 , 12.413 , 12.860.

11.060, 10.433 and 10.627 ton/Fad.for $b_1$, $b_2$, $b_3$, $b_4$ , $b_5$ and $b_6$ treatments, respectively. In 1978/1979 season, the averages were 9.860, 9.087 , 8.693 , 8.627 , 8.468 and 7.960 ton / Fad. for the same respective treatments. It is clear that application of phosphorus fertilizer early up to the second irrigation gave the best results in cutting 1.

It could be concluded that, application of 16 $P_2O_5$Kg/Fad. or 32 $P_2O_5$ Kg/Fad.before sowing time gave the maximum fresh yield/Fad.at the first cutting.

Cutting 2:

The difference between the averages fresh yield as affected by phosphorus application time in both seasons is highly significant. In 1977/ 1978 season the averages were 10.720,, 10.186, 8.920, 10.466, 10.447 and 9.720 ton/Fad. for $b_1$, $b_2$, $b_3$, $b_4$, $b_5$ and $b_6$ treatments, respectively. In 1978/1979 season the averages were 13.107, 12.087 , 10.67, 12.273, 12.670 and 11.730 tons/ Fad. for the same respective treatments. It is observed that addition of phosphorus before sowing gave a highest fresh yield/Fad.

Cutting 3.

With respect to phosphorus application time, it is clear that the differences between the averages fresh yield/ Fad. are significant. The averages in 1977/1978 were 5.000, 5.910, 6.293 , 6.207 , 7.560 and 8.247 ton/Fad. for $b_1$, $b_2$, $b_3$ , $b_4$ , $b_5$ and $b_6$ treatments, respectively. In 1978/1979 season, the averages were 9.620 , 10.560, 11.027 , 11.080 ,

12.233 and 12.733 tons for the same respective treatments. It is clear that application of phosphorus fertilizer on two portions, half the amount before the second cutting and the rest before the third cutting gave a highest fresh yield/Fad.

In cutting 1. The treatments in which phosphate was applied before planting or before the 1 st cutting i.e. treatments $b_1$, $b_2$ and $b_3$ gave a fresh yield greater than those treatments in which phosphate was not applied before planting or before the 1 st cutting. The fresh yield increased adversely by increasing the phosphate rate.

Treatments in which all the amount of phosphate was applied i.e. treatments $b_1$, $b_2$ and $b_3$ gave a yield greater than those treatments with which half the amount of phos- phosphate was applied i.e. treatments $b_4$ and $b_5$. This is due to the importance of phosphorus during this period of plant growth.(elongation and tillering). If we know that planting occured in December when the temperature decreased and this led to a decrease in the chemical and biological reactions occuring in the soil and thus consuming a great amount of phosphate present, we will conclude the importance of phosphate supply by soil application.

In cutting 2 the treatments $b_1$, $b_4$ and $b_5$ in which phosphorus was applied before planting gave a greater fresh yield than those produced by other treatments as plants

increased when supplied by phosphate during the early stage of growth following planting directly. The strength of these plants during that period will affect their growth and yield in the following cuttings and therefore we found that the olderly parts of the plant suffered more from phosphate deficiency than the younger plants because phosphorus is one of the elements transported from the elderly to the younger parts when it is deficient in the soil. The plants to which no phosphate was applied before planting suffered from phosphate deficiency especially the roots and thus affecting the absorption of water and nutrient elements and the efficiency of the plant to form new tillers was decreased.

In cutting 3 the treatment $b_6$ gave the highest fresh yield as compared with the other treatments. The difference between the averages fresh yield/Fad.was highly significant. Treatments $b_5$, $b_4$ and son on came next, respectively. Treatment $b_1$ gave the lowest fresh yield. The fresh yield/Fad. production was inversely proportional to the time between phosphate application and the 3 rd cutting. Treatment $b_6$ in which half the amount of phosphate was applied before the second cutting and the rest before the third cutting., gave the highest yield followed by treatment $b_5$ in which half amount of phosphate was applied before planting and the rest before the third cutting. Came next the treatment $b_4$ in which half the amount of phosphate was applied before planting

Average Values of fresh yield, in ton per faddan, as affected by phosphorus fertilizer rates(Table 46), and phosphorus application time (Table 47).

Table 46:

| cutting | season | $P_2O_5$ kg/Fad. | | | L.S.D | |
|---|---|---|---|---|---|---|
| | | 0 | I6 | 32 | I% | 5% |
| cut.I | I977/78 | 7.643 | I3.700 | I3.I33 | 0.536 | 0.349 |
| | I978/79 | 7.790 | 9.373 | 9.030 | I.02 | 0.705 |
| | Combined | 7.7I6 | II.536 | II.082 | 0.598 | 0.362 |
| cut.2 | I977/78 | 8.I77 | II.8I3 | I0.453 | 0.6I0 | 0.4I0 |
| | I978/79 | I0.733 | I2.307 | I3.427 | 0.472 | 0.324 |
| | Combined | 9.455 | I2.060 | II.940 | 0.436 | 0.344 |
| cut.3 | I977/78 | 4.567 | 8.329 | 6.759 | 0.875 | 0.602 |
| | I978/79 | 5.290 | I4.5I2 | I3.776 | 0.629 | 0.432 |
| | Combined | 4.929 | II.42I | I0.268 | 0.927 | 0.657 |
| Total | I977/78 | 20.387 | 33.872 | 30.345 | I.523 | I.047 |
| | I978/79 | 23.8I3 | 36.I93 | 36.233 | I.778 | I.220 |
| | Combined | 23.I00 | 34.0I8 | 33.289 | 2.020 | I.772 |

Table47:

| cutting | season | Phosphorus application times | | | | | | L.S.D | |
|---|---|---|---|---|---|---|---|---|---|
| | | $b_I$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | 1% | 5% |
| cut.I | I977/78 | II.747 | I2.4I3 | I2.860 | II.000 | I0.433 | I0.627 | 0.550 | 0.4I5 |
| | I978/79 | 9.860 | 9.087 | 8.693 | 8.627 | 8.468 | 7.960 | 0.556 | 0.50I |
| | Combined | I0.804 | I0.750 | I0.777 | 9.8I4 | 9.45I | 9.294 | 2.43I | I032I |
| cut.2 | I977/78 | I0.720 | I0.I86 | 8.920 | I0.466 | I0.447 | 9.220 | 0.5I6 | 0.388 |
| | I978/79 | I3.I07 | I2.087 | I0.967 | I2.273 | I2.760 | II.730 | 0.73I | 0.550 |
| | Combined | II.9I3 | II.I37 | 9.944 | II.369 | II.604 | I0.725 | 0.543 | 0.343 |
| cut.3 | I977/78 | 5.000 | 5.9I0 | 6.293 | 6I207 | 7.560 | 8.247 | 0.452 | 0.340 |
| | I978/79 | 9.620 | I0.560 | II.027 | II.080 | I2.233 | I2.733 | 0.III | 0.084 |
| | Combined | 7.3I0 | 8.235 | 8.660 | 8.643 | 9.897 | I0.490 | 0.450 | 0.365 |
| Total | I977/78 | 27.467 | 28.509 | 28.073 | 27.673 | 28.440 | 28.594 | I.56I | I.I74 |
| | I978/79 | 32.587 | 3I.784 | 30.687 | 3I.980 | 33.46I | 32.423 | I.358 | I.I70 |
| | Combined | 30.027 | 30.I22 | 29.380 | 29.827 | 30.95I | 30.509 | I.088 | 0.822 |

and the rest before the second cutting. Treatments $b_3$ , $b_2$ and $b_1$ then followed. Treatment $b_1$ gave the lowest fresh yield in the 3 rd cutting as all the amount of phosphate was applied before planting.

This graduation in the amount of fresh yield in the 3 rd cutting is proportional to the graduation of available phosphate in the soil in the period between the 2 nd and 3 rd cuttings. In the treatments in which phosphate was applied in earlier time to the 3 rd cutting e.g. treatments $b_5$ and $b_6$ helped the increase of the amount of the available phosphorus in the soil more than the treatments in which phosphate was applied before planting.

Total fresh yield:

The treatment $b_5$ in which half the amount of phosphate was applied before planting and the rest before the third cutting , gave the highest total fresh yield in a highly significant difference than those in treatments $b_3$ and $b_4$ and in a significant difference that those in treatments $b_1$ and $b_2$, while there were no significant difference between treatments $b_5$ and $b_6$ or $b_1$, $b_2$ , $b_4$ and $b_6$.

Treatment $b_5$ exceeded other treatments in total fresh yield due to the distribution of phosphate application process in times more suitable than other treatments. The application of half the amount of phosphate before planting keeps to the growing plants their need of available phosphorus and helps

them early in the formation of strong roots with high efficiency in supplying the plant with water and nutrient elements and therefore the plants become highly growing having many tillers with a high fresh yield in the 1 st and 2 nd cuttings. The application of half the amount of phosphate before the third cutting supply the plant with a suitable amount of available phosphorus helping it in good growing and producing a high yield. The approximation of the effects of treatments $b_1$, $b_2$ , $b_4$ and $b_6$ on the total fresh yield was due to variation in their effects on the yield of the 1 st , 2 nd and 3 rd cuttings and the stability of this effect on total fresh yield.

These results agree with those obtained by Bashbishy (1976) and Abdel-Gawad et al (1977), whereas they disagree with that obtained by El-Damaty(1962) due to the metorological factors.

Effect of the interaction between phosphorus fertilizer rates and application times of phosphorus:

Table 48: shows the average values of total fresh yield as affected by the interaction between phosphorus fertilizer rates and time of application. The results showed the superiority of treatment $b_5$ due to the application of half the amount of phosphorus before planting and the other half before the second cutting with 16 $P_2O_5$ Kg/Fad. rate over the other treatments. The difference between the averages

of treatments $b_1$, $b_4$ and $b_6$ was significant, whereas between the treatments $b_2$ and $b_3$ was highly significant with 16 $P_2O_5$ Kg/Fad. treatment.

This was due to the more suitable distribution of phosphate during the period of plant growing.

Table 48: Average values of fresh yield, in ton/fad., as affected by the interaction between phosphorus fertilizer rates and phosphorus application time.

| $P_2O_5$ Kg/Fad. | Phosphorus application times | | | | | | L.S.D. | |
|---|---|---|---|---|---|---|---|---|
| | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | 1% | 5% |
| 0 | 20.930 | 22.720 | 23.510 | 20.840 | 21.400 | 23.200 | 1.942 | 0.903 |
| 16 | 34.920 | 34.660 | 33.444 | 35.132 | 36.816 | 35.136 | | |
| 32 | 34.232 | 32.048 | 31.984 | 33.510 | 43.636 | 33.109 | | |

## 6. DRY YIELD

Effect of phosphorus fertilizer rates:

The averages of dry yield, ton/Fad. and the total dry yield of the three cuttings are shown in table 49 for 1977/1978 and 1978/1979 seasons.

At the first cutting the average of dry yield was affected significantly due to the phosphorus fertilizer rates in the two seasons. In 1977/1978 , the averages were 0.907, 1.703 and 1.636 ton/Fad. for 0,16 and 32 $P_2O_5$ Kg/Fad., respectively. In 1978/1979, the averages were 0.926 , 1.232 and 1.122 ton/Fad. for the same respective treatments.

It is clear that applying phosphorus at 16 $P_2O_5$ Kg/Fad. gave the maximum dry yield. The dry yield of second cutting during the two seasons increased significantly due to the phosphorus fertilizer rates. The averages of 1977/1978 season were 1.189, 1.822 and 1.711 ton/Fad. for 0 , 16 and 32 $P_2O_5$ Kg/Fad., respectively. The same respective treatments averaged 0.926 , 1.232 and 1.122 tons in 1978/ 1979 season. The average of the two seasons were 0.916 , 1.468 and 1.379 ton/Fad. for the same respective treatments. It is clear that application of 16 $P_2O_5$ Kg/Fad. gave the highest dry yield in the second cutting.

At the third cutting, the results in both seasons indicate that there were a significant differences between dry yield values due to phosphorus fertilizer rates. The

averages in 1977/1978 were 0.931 , 2.120 and 3.682 ton/Fad. for 0,16 and 32 $P_2O_5$ Kg/Fad. treatments, respectively, whereas the average values in 1978/1979 season were 1.067, 3.697 and 3.817 ton/Fad. for the same respective treatments. It is clear that increasing phosphorus fertilizer rate up to 32 $P_2O_5$ Kg/Fad. gave the maximum dry yield/Fad. in the third cutting.

The addition of higher phosphorus (32 $P_2O_5$ Kg/Fad.) lead to increase the dry yield. It was evident that the increase in dry yield resulted from the increase in plant height, number of tillers / plant and weight per plant. These results agree with those obtained by Brown (1959) , Kandil (1973) , Lutz (1973) , Singh (1973), Bashbishy(1976) and Hefni et al (1978).

Effect of Phosphorus application times:

The results illustrated in table (50) indicate that the differences between dry yield values were affected significantly due to the phosphorus application time in the two seasons.

In 1977/1978 the averages of the first cutting were 1.686 , 1.683 , 1.505 , 1.299 , 1.094 and 1.177 ton/Fad. for $b_1$, $b_2$, $b_3$, $b_4$, $b_5$ and $b_6$ treatments, respectively. The averages were, 1.374 , 1.209 , 1.102, 1,093 , 0.941 and 0.843 ton/Fad. for the same, respective treatments. Addition of phosphorus before sowing time during the both season gave the highest dry yield as compared with the other treatments.

There was a significant differences between the average values of dry yield as affected by the time of phosphorus application.
In 1977/1978 , the averages were 1.751, 1.548 , 1.540 , 1.691, 1.704 and 1.403 ton/Fad. for $b_1$, $b_2$ , $b_3$,$b_4$, $b_4$ and $b_6$ treatments, respectively. The same treatments averaged 2.293 , 1.946 , 1.601 , 1.884 , 1.942 and 1.715 ton/Fad. in 1978/ 1979 season. It is observed that addition of phosphorus before sowing, gave a maximum dry yield.

Cut. 3:

The differences between the averages of dry yield in both seasons were significant. In 1977/1978 season, the average were 1.965 , 2.019, 2.180, 2.170, 2.427 and 2.634 ton /Fad. for $b_1$, $b_2$, $b_3$, $b_4$, $b_5$ and $b_6$ treatments, respectively. In 1978/1979 season, the averages were 2.250 , 2.573 , 2.713, 2.700 , 3.274 ton/Fad. for the same respective treatment. It could be concluded that , addition of phosphorus on two portions, half the amount before the second cutting and the rest before the third cutting gave the maximum dry yield at the third cutting both seasons of experimentation.

The effect of phosphate application times on the dry yield was similar to that on the fresh yield in the 1 st , 2 nd and 3 rd cuttings. Phosphate application before planting and before the 1 st cutting led to an increase in dry yield in the 1 st and 2 nd cuttings and phosphate

Table 49: Average values of dry ,yield in ton/ fad., as affected by phosphorus fertilizer rates.

| Cutting | Season | $P_2O_5$ Kg / Fad. | | | L.S.D. | |
|---|---|---|---|---|---|---|
| | | 0 | 16 | 32 | 1% | 5% |
| Cut. I | 1977/ 1978 | 0.907 | 1.703 | 1.636 | 0.124 | 0.096 |
| | 1978/ 1979 | 0.920 | 1.232 | 1.122 | 1.121 | 0.082 |
| | combined | 0.916 | 1.468 | 1.379 | 0.077 | 0.069 |
| Cut. 2 | 1977/ 1978 | 1.189 | 1.822 | 1.711 | 0.091 | 0.62 |
| | 1977/ 1979 | 1.504 | 1.975 | 2.237 | 0.111 | 0.075 |
| | combined | 1.347 | 1.889 | 1.974 | 0.163 | 0.146 |
| Cut. 3 | 1977/ 1978 | 0.931 | 2.120 | 3.682 | 0.289 | 0.198 |
| | 1978/ 1979 | 1.067 | 3.697 | 3.817 | 0.117 | 0.079 |
| | combined | 0.999 | 2.909 | 3.749 | 0.536 | 0.399 |
| Total | 1977/ 1978 | 3.027 | 5.645 | 6.756 | 1.488 | 0.322 |
| | 1978/ 1979 | 3.497 | 6.904 | 7.176 | 0.241 | 0.266 |
| | combined | 3.262 | 6.225 | 6.966 | 1.011 | 0.970 |

application after the 1 st cutting and before the third cutting led to an increase in the dry yield in the 3 rd cutting.

Results showed that the total dry yield was not significantly affected due to the phosphate application times. This was due to the different effects of phosphate application times on the 1 st , 2 nd and 3 rd cuttings. Treatments led to an increase in the yield of the 1 st and 2 nd cuttings ( $b_1$ and $b_2$) was accompanied by a decrease in the yield in the 3 rd cutting., and the treatments led to a decrease in the hield in the 1 st and 2 nd cutting. These results agree with that obtained by Bashbishy (1976).

Effect of the interaction between phosphorus fertilizer rates and application times of phosphorus:

Table 51: shows the averages dry yield ton /Fad.as affected by the interaction between phosphorus fertilizer rates and application times of phosphorus.

Treatment $b_1$ i.e. ( application of all the amount of phosphate before planting) gave the highest dry yield with 32 kg $P_2O_5$/Fad. rate as compared with the other treatments. Came next the treatment in which half the amount of phosphate was applied before planting and the rest before the third cutting, with 32 Kg $P_2O_5$/Fad.rate. This result , because the applicationof phosphate in large amounts before planting gave

a suitable amount of available phosphorus and encourage the plants to form strong system of roots which having a great absorping surface to supply the plant with water and nutrient elements and this in turn resulted in increasing the dry yield.

In the treatment $b_5$, application of 16 kg $P_2O_5$/ Fad. rate before planting was sufficient for plant needs of phosphorus necessary for good growing and the production of a great dry yield in the 1 st and 2 nd cuttings.

The application of another 16 kg $P_2O_5$/ Fad.rate before the third cutting led to encourage the growth and formation of dry matter which needs the presence of a suitable amount of available phosphorus.

(Table 50) Average values of dry yield, in ton/fad., as affected by phosphorus application time.

| cutting | season | Phosphorus application times | | | | | | L.S.D | |
|---|---|---|---|---|---|---|---|---|---|
| | | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | I% | 5% |
| out.I | I977/78 | I.686 | I.683 | I.505 | I.299 | I.094 | I.I77 | 0.I06 | 0.080 |
| | I978/79 | I.374 | I.209 | I.I02 | I.093 | 0.94I | 0.843 | 0.060 | 0.060 |
| | COMBINED | I.530 | I.446 | I.304 | 0.096 | I.0I8 | I.0I0 | I?364 | 0.232 |
| out.2 | I977/78 | I.75I | I.548 | I.540 | I.69I | I.704 | I.403 | 0.09I | 0.062 |
| | I978/79 | 2.295 | I.946 | I.60I | I.884 | I.942 | I.7I5 | 0.I4I | 0.I05 |
| | Combined | 2.022 | I.747 | I.570 | I.788 | I.823 | I.559 | 0.759 | 0.539 |
| out.3 | I977/78 | I.965 | 2.0I9 | 2.I80 | 2.I70 | 2.427 | 2?634 | 0.I86 | 0.I40 |
| | I978/79 | 2.250 | 2.573 | 2.7I3 | 2.700 | 3.274 | 3.667 | 0.I73 | 0.I3I |
| | Combined | 2.I08 | 2.296 | 2.447 | 2.435 | 2.85I | 3.I5I | 0.78I | 0.498 |
| Total | I977/78 | 5.402 | 5.250 | 5.225 | 5.I60 | 5.225 | 5?2I4 | 0.I.I | 0.084 |
| | I978/79 | 5.9I7 | 5.728 | 5.4I6 | 5.677 | 6.I57 | 6.225 | 0.279 | 0.2I0 |
| | Combined | 5.660 | 5.489 | 5.32I | 5.4I9 | 5.69I | 5.220 | 0.7I6 | 0.457 |

(Table 5I) Average Values of dry yield, in ton/fad. ad affected by the interaction between phosphorus fertilizer rates and phosphorus application time.

| $P_2O_5$ Kg/fad | Phosphorus application times | | | | | | L.S.D | |
|---|---|---|---|---|---|---|---|---|
| | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | I% | 5% |
| 0 | 3.II9 | 3.429 | 3.292 | 3.253 | 3.094 | 3.384 | | |
| 16 | 6.242 | 6.078 | 5?885 | 6.036 | 6.678 | 6.730 | | |
| | 7?6I9 | 6?96I | 6.789 | 6.969 | 7.302 | 7.045 | I?366 | 0.I88 |