ADAPTATION OF SOME ONION CULTIVARS UNDER MIDDLE DELTA CONDITIONS IN RELATION TO NITROGEN FERTILIZATION.

I- Growth, bulbing behaviour and nutritional status.

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تأقلم بعض أصناف البصل تحت ظروف منطقة وسط الدلتا وعلاقة ذلك بالتسميد النتروجينى

١- النمو ، سلوك التبصيل والحالة الغذائية

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ملخص البحث

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بالجميزة لدراسة أقلمة ثلاثة أصناف من البصل هى جيزة ٢٠ ، جيزة ٦ محسن ، وشندويل ١ تحت ظروف وسط الدلتا وعلاقة ذلك بمستوى التسميد الآزوتى المضاف (صفر ، ٣٠ ، ٦٠ ، ٩٠ كجم نتروجين / فدان) وكذلك عدد مرات اضافته (مرتين أو ثلاثة).

وأوضحت الدراسة الآتى :ـ

ـ تفوق الصنف جيزة ٢٠ فى قياسات النمو كما تميز بوجود أعلى محتوى من البوتاسيوم فى الأوراق، والفوسفور والبوتاسيوم والكربوهيدرات الكلية فى الأبصال الناضجة . ولقد أعطى الصنف شندويل ١ أعلى نسبة تبصيل بصورة معنوية وتلاه فى ذلك جيزة ٦ ثم جيزة ٢٠ .

ـ زيادة مستوى التسميد النتروجينى أدت الى زيادة معنوية فى نمو الأوراق والأبصال ـ كما أدت الى زيادة قطر العنق وقطر البصلة ولكن أدت الى نقص غير معنوى فى نسبة التبصيل ـ وقد لوحظ أن النباتات التى سمدت بمعدل ٦٠ كجم آزوت / فدان أظهرت أعلى محتوى من النتروجين ، الفوسفور والبوتاسيوم فى الأوراق ، أما تلك التى سمدت بمعدل ٩٠ كجم نتروجين / فدان فقد حققت أعلى محتوى من العناصر فى الأبصال الغير ناضجة والناضجة.

- كان لعدد مرات اضافة السماد الآزوتى تأثير معنوى على نمو نباتات البصل ولكن لم يكن له تأثير معنوى على مؤشرات التبصيل .
أيضا فان اضافة السماد الآزوتى على دفعتين متساويتين أدى الى زيادة ، بوجه عام ، فى المحتوى من النتروجين والفوسفور والبوتاسيوم فى جميع أجزاء النبات ، بينما كانت الاضافة على ثلاثة دفعات أكثر تأثيرا فى زيادة الكربوهيدرات الكلية .

- لم يكن للتفاعل بين العوامل تحت الدراسة ، بوجه عام ، تأثير معنوى على النمو أو سلوك التبصيل فى البصل ، كما أن العديد من حالات التفاعل قد تم مناقشتها فيما يتعلق بالحالة الغذائية للنباتات .

ABSTRACT

Two field experiments were conducted at the Gemmeiza Agricultural Research Station to study the adaptation of three onion cultivars, i.e. Giza 20, Giza 6 M. and Shandaweel No. 1 under middle Delta conditions in relation to nitrogen level, i.e. 0, 30, 60 and 90 kg. N/fed., and number of applications, i.e. twice or three times.

Giza 20 cv. approved to be of superior growth parameters. It also had the highest K in leaves and P, K and total carbohydrates in mature bulbs. Shandaweel No. 1 cv. significantly had the highest bulbing ratio followed by Giza 6 and Giza 20 cvs., respectively.

Increasing N- fertilizer level significantly enhanced foliage and bulbs growth. It also increased bulb and neck diameters but insignificantly reduced bulbing ratio. Plants received 60 kg. N/fed. have the highest N, P and K contents in leaves, whereas those of 90 kg. N/fed. are of highest nutrients content in either immature and mature bulbs.

Number of N- fertilizer applications significantly affected growth of onion plants but had no significant effect on bulbing indices. Splitting N- dose for equally twice applications generally increased N, P and K contents in all plant organs, whereas the three equally applications approved more effective in increasing total carbohydrate contents.

The interaction between the tested factors exerted, in general, no significant effect on growth or bulbing behaviour of onion plants. Besides, several interactive effects on nutritional status in plants were observed.

INTRODUCTION

Determining nutrient requirements considered as one of the most important factors to affect growth, bulbing behaviour and nutritional status in onion. Nitrogen was frequently reported in the literature to increase foliage and bulbs growth of onion (El-Habbasha and El-Haroun, 1977 and Wilson, 1978). Besides, bulbing was earlier with low nitrogen level (Basilious, 1975 and Moustafa, 1979). Delaying nitrogen application delayed bulbs formation and showed to be determintal for onion growth (Wilson, 1978).

Shandaweel No. 1 and Giza 6 M cvs., which cultivated in middle and upper Egypt and well known to be of earlier maturity (Ahmed et al., 1977), were choiced to study their adaptation under middle Delta conditions in addition to Giza 20 cv. which characterized by uniformity in bulbs shape and colour (El-Gammal, 1980) and well adapted to grow in this region.

Studying to what extent Shandaweel No. 1 and Giza 6 M cvs. could be adapted to the conditions of middle Delta region, comparable to Giza 20 cv., on one hand and estabilizing the more efficient nitrogen level along with its optimum number of application on the other hand, are the main goals of this work. In this way, growth, bulbing behaviour and nutritional status of the tested cultivars were facused.

MATERIALS AND METHODS

Two field experiments were carried out at the Gemmeiza Agricultural Research Station of the middle Delta region to study the response of three onion cultivars i.e., Shandaweel No. 1, Giza 6 M and Giza 20 to nitrogen fertilizer level along with its number of

applications. Ammonium sulphate was added at rates of 30, 60 and 90 kg. N/fed. either twice or splitted at three times of applications, i.e. 55 and 75 days and 55, 75 and 95 days from transplanting, respectively. Split split-plot design with four replications was adopted, where cultivars occupied the main plots, whereas nitrogen level and its number of applications were arranged as sub and sub sub-plot, respectively. Seeds were sown in the nursery on October 15th in both seasons, whereas transplanting took place on January 9th and 12th in 1984 and 1985, seasons. The experimental plot was of 10 m in area and includes 6 ridges each of 50 cm wide and 3.5 m. in long. The cultural practices were completed by the tradional methods for such crop.

The recommended fungicides and pesticides with their programme of application were respected. During the growth period, plant samples, ten plants were undertaken from the two outer ridges of each experimental plot at 120 days from transplanting and used for growth and bulbing behaviour studies (Manna, 1952).

The following growth and bulbing parameters were recorded:

1- Plant length (cm.) measured from the base of swelling sheat to the tip of the longest assimilative tubular blades.
2- Neck length (cm.) from the top of the swelling sheat to the end of the sheat.
3- Number of assimilative leaves/plant.
4- Fresh and dry weights of leaves, necks and bulbs.
5- Bulbing ratio, measured as the rates of the greatest diameter of bulbs to the minimum neck diameter (Manna, 1952).

Nitrogen, phosphorus and potassium were determined in leaves and bulb which were previously used in growth and bulbing studies, i.e. 120 days from transplanting, and in harvested mature bulbs.

The methods of Chapman and Partt (1961), Troug and Mayer (1939) and Brown and Lilleland (1946) were adopted for N, P, and K determinations, respectively. In harvested mature bulbs, total carbohydrates content was also determined using the method descriped by Megnitski et al. (1959).

The obtained data were exposed to the proper statistical analysis of variance (Snedecor and Cochran, 1967) and the Duncan's multiple range test at 5% level was used for the comparison among means (Duncan, 1955).

RESULTS AND DISCUSSION

1- Growth:

1-1- Effect of cultivars:

Data in Table (1) indicate that Giza 20 cv. is of superior growth indices, since it had the highest records in plant and neck length, number of leaves per plant as well as fresh and dry weights of different plant organs, i.e. leaves, necks and bulbs. This result was insistently observed in both growing seasons. Giza 20 cv. was followed by Giza 6 M cv. and Shandaweel No. 1 cv. came the latest one.

Obtained results coinside with those of El-Shafie et al.(1971), who reported that foliage and bulbs growth was more vigorious in Behairy cv. (from which Giza 20 was initiated) as compared to Giza 6 M cv.

The superiority of Giza 20 cv. in bulbs growth may be explained as bulb has more complete entire rings and large number of growing points. This drawn conclusion goes along with the results of Ahmed et al. (1977) who interpreted results on heriditical basis.

Table 1. Effect of cultivars and nitrogen fertilizer level, along with its number of applications on growth characteristics of onion plants 120 days from transplanting .

Studied variations	1983/1984								1984/1985							
	Plant height (cm)	Neck length (cm)	No.of leaves per plant	Leaves		Neck		Bulb		Plant height (cm)	Neck length (cm)	No.of leaves per plant	Leaves		Neck		Bulb	
				F.Wt. (gm/ plant)	D.Wt. (gm/ plant)	F.Wt. (gm/ plant)	D.Wt. (gm/ plant)	F.Wt. (gm/ plant)	D.Wt. (gm/ plant)				F.Wt. (gm/ plant)	D.Wt. (gm/ plant)	F.Wt. (gm/ plant)	D.Wt. (gm/ plant)	F.Wt. (gm/ plant)	D.Wt. (gm/ plant)
Cultivars:																		
Giza 20	59.29 a	11.78 a	8.61 a	47.94 a	4.97 a	27.81 a	2.85 a	71.76 a	8.25 a	68.66 a	14.23 a	6.61 a	40.93 a	3.62 a	19.53 a	2.10 a	70.66 a	9.77 a
Giza 6M	45.17 b	10.21 b	6.10 b	19.69 b	2.29 b	15.32 b	1.46 b	47.84 b	5.58 b	52.60 b	10.90 b	5.90 b	19.33 a	1.98 b	11.33 b	1.1e b	53.19 b	6.58 b
Shandaweel No.1	39.85 c	9.11 c	4.94 c	11.55 c	1.54 c	13.97 b	1.28 b	46.33 b	5.84 b	51.73 b	10.71 b	5.38 c	18.64 b	1.80 b	9.85 b	0.95 b	56.92 b	6.87 b
N-fertilizer level(KgN/Fed.)																		
30	46.48 b	10.52 a	6.10 b	24.07 b	2.54 b	17.43 b	1.66 b	51.31 b	6.04 c	53.57 b	10.84 b	5.64 b	21.90 c	2.05 c	10.95 b	1.00 c	54.44 c	6.74 c
60	47.65 b	10.11 a	6.90 a	28.37 a	3.21 a	20.41 a	1.99 a	56.59 a	6.57 b	58.69 a	12.21 a	5.91 b	26.50 b	2.56 b	12.73 b	1.34 b	60.68 b	7.78 b
90	50.01 a	10.47 a	6.64 a	26.74 ab	3.04 a	19.27 ab	1.95 a	58.04 a	7.05 a	60.74 a	12.78 a	[illegible] a	30.50 a	2.88 a	17.84 a	1.72 a	[illegible]	[illegible] a
No.of N-fertilizer applications :																		
2	48.41 a	10.37 a	6.59 a	26.01 a	2.96 a	19.59 a	1.91 a	56.57 a	6.73 a	58.17 a	12.32 a	5.93 a	26.48 a	2.53 a	13.25 a	1.38 a	61.31 a	7.94 a
3	47.82 a	10.36 a	6.50 a	26.77 a	2.90 a	18.48 a	1.82 a	54.06 a	6.38 a	57.16 a	11.77 a	6.00 a	26.13 a	2.47 a	13.08 a	1.39 a	59.19 a	7.54 b

x Means separation in columns by Duncan's multiple range test 5 % level .

x Values in the same column followed by the same letter don't differ significantly .

1-2- Effect of nitrogen fertilizer level:

Except for the neck length, increasing N- fertilizer level seams to enhance foliage and bulbs growth in both seasons of study (Table 1). In this connection, the medium level of applied N, i.e. 60 kg. N/fed. was more effective for increasing number of leaves per plant and fresh and dry weight in leaves and bulbs. This result is true in 1983/1984 season only. The highest N- level, i.e. 90 kg./fed., being of superior effect on plant length and bulbs fresh and dry weights in 1983/1984 season. It also approved superiority in regards to the studied parameters of leaves and bulbs growth in 1984/1985 season. Results may be discussed as nitrogen initially favoured vegetative growth of onion plants, and thereby may increase the amount of migrated metabolities towards bulb as storage organ.

Increasing N- level was reported also by Habbasha and El-Haroun (1977) and Moustafa (1979) to improve foliage and bulbs growth in onion.

1-3- Effect of number of nitrogen fertilizer applications:

Number of N- fertilizer applications had no significant effected on growth parameters of onion plants, although the twice additions seem to have somewhat superiority in this respect as compared to the tripple ones (Table 1). Splitting N- doses for three additions gave the opportunity to add a part of fertilizer at latened growth stage, thus it was expected to be of no effect or further to reduce bulbs growth. This drawn conclusion goes along with the results of Basilous (1975) who found that delaying nitrogen application reduced foliage and bulbs growth in onion.

1-4- The interactions effect:

With a slight descrepancies, growth parameters insignificantly responded to the different interactions of cultivar and level and

number of N- applications, so its related data were descarded. This result may be explained as each studied factor acts independently on growth parameters.

2- Bulbing behaviour:

Bulbing behaviour was expressed in this study as bulb and neck diameters as well as bulbing ratio.

2-1- Effect of cultivars:

Bulbing behaviour in onion seemed to vary depending on grown cultivar (Table 2). The highest bulbing ratio was observed in Shandaweel No. 1 cv., where the least records in bulb and neck diameters were generally obtained. Besides, Giza 20 cv. achieved the highest bulb and neck diameter, but seems to be of least bulbing ratio. These results are true in both seasons of study. In this connection Giza 6 M cv. followed Giza 20 in bulb and neck diameters, but exceeded it in bulbing ratio.

Results could be explained due to the variation among cultivars in photoperiod required for bulbing. Thus, Shandaweel No. 1 and Giza 6 M cvs. are grown normally at souther Nile vally and reported to be of less photoperiod requirements (Warid and El-Gammal, 1959). This character gave the opportunity for early and good bulbing processes as cultivars grow under the more longer photoperiod of northern Nile vally, i.e., Delta region.

Obtained results are in agreement with those of El-Shafie et al. (1971). They found that Giza 6 M cv. reached bulbing ratio (neck/bulb) of 0.50 at 18 to 30 th of March under Delta conditions, whereas Behairy (in which from it Giza 20 cv. was initiated) reached the same bulbing ratio on 12 to 14th April. Further confirmation was done by Ahmed et al. (1971) who observed that Shandaweel No. 1 cv. produced mature bulbs 12-15 days earlier than Giza 6 M cv.

Table (2):Effect of grown cultivars and nitrogen fertilizer levels along with its number of applications, on some bulbing indices in onion ,120 days frome transplanting .

Bubing indices / Studied variations	1983/1984 Bulb diameter (cm)	1983/1984 Neck diameter (cm)	1983/1984 Bulbing ratio (Bulb/Neck)	1984/1985 Bulb diameter (cm)	1984/1985 Neck diameter (cm)	1984/1985 Bulbing ratio (Bulb/ Neck)
Cultivars						
Giza 20	5.84 a	1.98 a	2.96 b	5.70 a	2.00 a	2.86 b
GIZA 6M.	4.55 a	1.37 b	3.30 a	4.73 b	1.52 b	3.14 c
Shandaweel NO.1	4.30 b	1.26 b	3.43 a	5.00 b	1.44 b	3.49 a
N-fertilizer levels(KgN/Fed.)						
30	4.55 b	1.37 b	3.36 a	4.65 c	1.41 c	3.35 a
60	4.99 a	1.58 a	3.19 a	5.19 b	1.71 b	3.09 a
90	5.14 a	1.65 a	3.14 a	5.58 a	1.84 a	3.06 a
NO.of N-fertilizer applications						
2	4.98 a	1.53 a	3.28 a	5.22 a	1.66 a	3.21 a
3	4.81 a	1.54 a	3.18 a	5.06 a	1.65 a	3.12 a

* Means separation in column by Duncan's multiple range test 5 % level .

* Values in the same column followed by the same level don't differ significantly .

2-2- Effect of nitrogen fertilizer levels:

Data in Table (2) show that increasing N-fertilizer level linearly increased bulb and neck diameters of onion plants, so the 90 kg./fed. level being of the highest records. Vice versa was occurred with bulbing ratio. These results were insistently observed in both seasons of study.

The obtained results are in harmony with those of Basilious (1975) who found that bulbing was earlier with lower levels of nitrogen. Further confirmation was done by Moustafa (1979), who reported that bulbing was earlier in non-fertilized plots of onion.

2-3- Effect of number of nitrogen fertilizer applications:

Number of nitrogen fertilizer applications insignificantly affected bulbing indices as measured 120 days from transplanting. In spite of that, a slight increases in bulb diameter and bulbing ratio were noticed due to the twice additions of N-fertilizer as compared to the tripple ones (Table 2). Results may explained as the twice fertilizer applications encouraged earlier bulbing, whereas splitting N-fertilizer for three equally doses delayed it. This drawn conclusion goes along with the results of Tseng (1972) and Basilious (1975), who reported that bulbing in onion plants was delayed due to the latned nitrogen application.

2-4- The interactins effect:

All of the studied interactions between tested factors seemed to have no significant effect on bulbing behaviour in onion, so its related data were excluded. The absence of significances means again that each of the tested factors acted, in this connection, independently.

3- Nutritional status:

3-1- Effect of cultivars:

As it can be seen in Fig. (1), Giza 20 cv. elaborated higher K contents in leaves, so it was followed in this connection by Giza 6 M and Shandawell No. 1, in descending order. Note that Shandaweel No. 1 cv. was observed to be of high P content in leaves followed by Giza 20 cv. and Giza 6 M came the latest. The highest N, P and K contents in immature bulbs were found in Giza 6 M followed by Shandaweel No. 1. Giza 20, however, rankes the last in P and K contents in immature bulbs.

Giza 6 M seems to be of higher P and K contents in mature bulbs, whereas the highest N being obtained in Shandaweel No. 1 cv. where the least total carbohydrates percentage was recorded (Fig. 2). In this connection, Giza 20 cv. attained the least N P K contents in mature bulbs, where the highest amount of total carbohydrates was elaborated. Similar varietal variations in nutrients and carbohydrate contents in onion leaves and bulbs were reported by El-Shafie et al. (1979) and El-Kafoury (1986). Results could be explained as onion cultivars differed in nutrients requirement, factor that may affect nutrients absorption and accumulation in plant tissues. This conclusion was previously drawn by Midan et al. (1985) and Midan and Gabal (1986) on potato and peppers.

3-2- Effect of nitrogen fertilizer level:

Data regarding N, P, K and total carbohydrate contents in onion leaves and bulbs as affected by N-level are presented in Figs. (1&2). It is obviously clear that plants received N-fertilizer at the rate of 60 kg. N/fed. are of higher N, P and K contents in leaves. Besides, the highest N-fertilizer rate, i.e. 90 kg. N/fed., caused, with a slight exceptions, superior N, P and K contents in either immature and mature bulbs. These results are in confirmity with those of

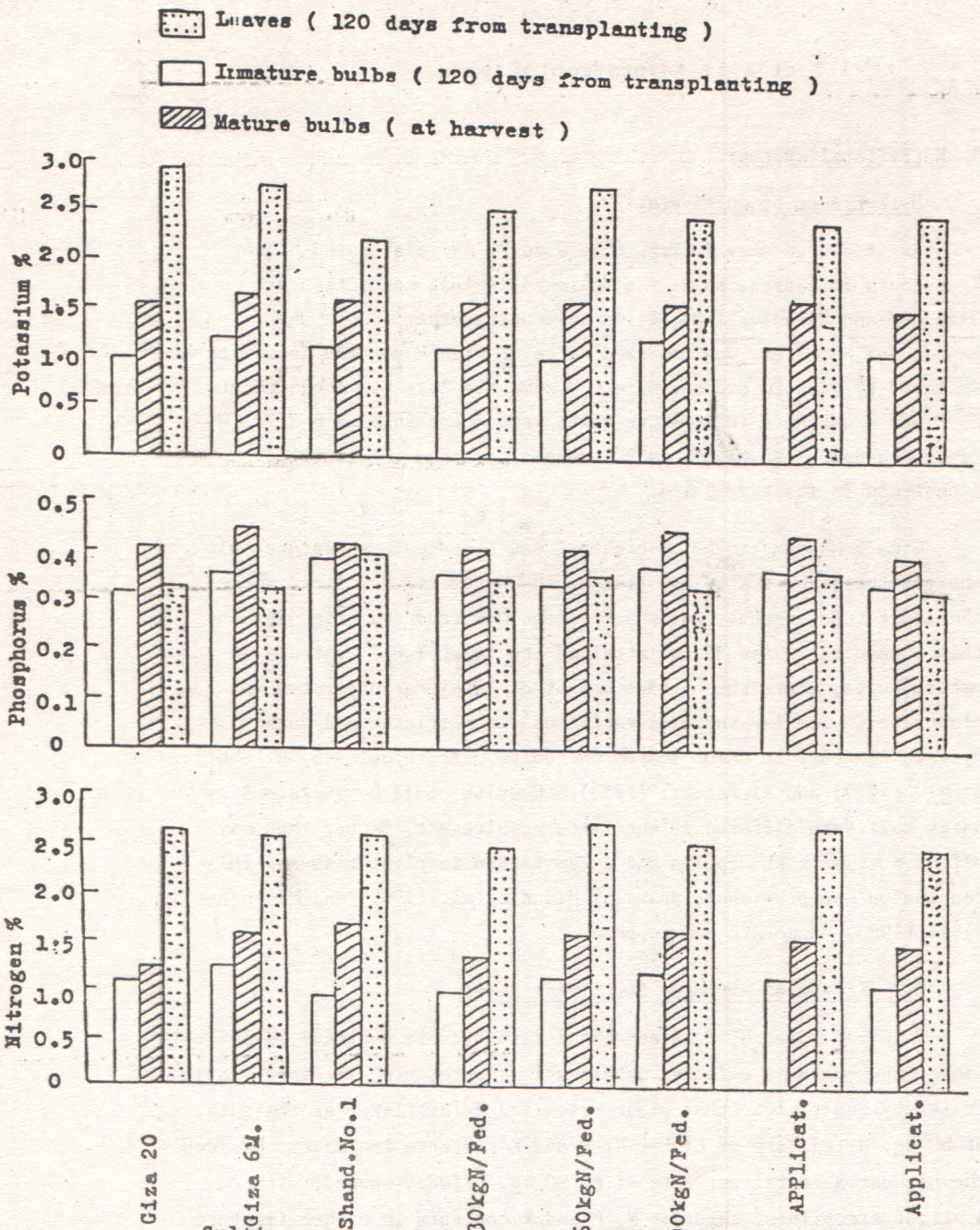

Fig. (1) . Effect cultivars and nitrogen fertilizer level along with its number of applications on N,P and K contents in onion plants grown in 1984/1985 season .

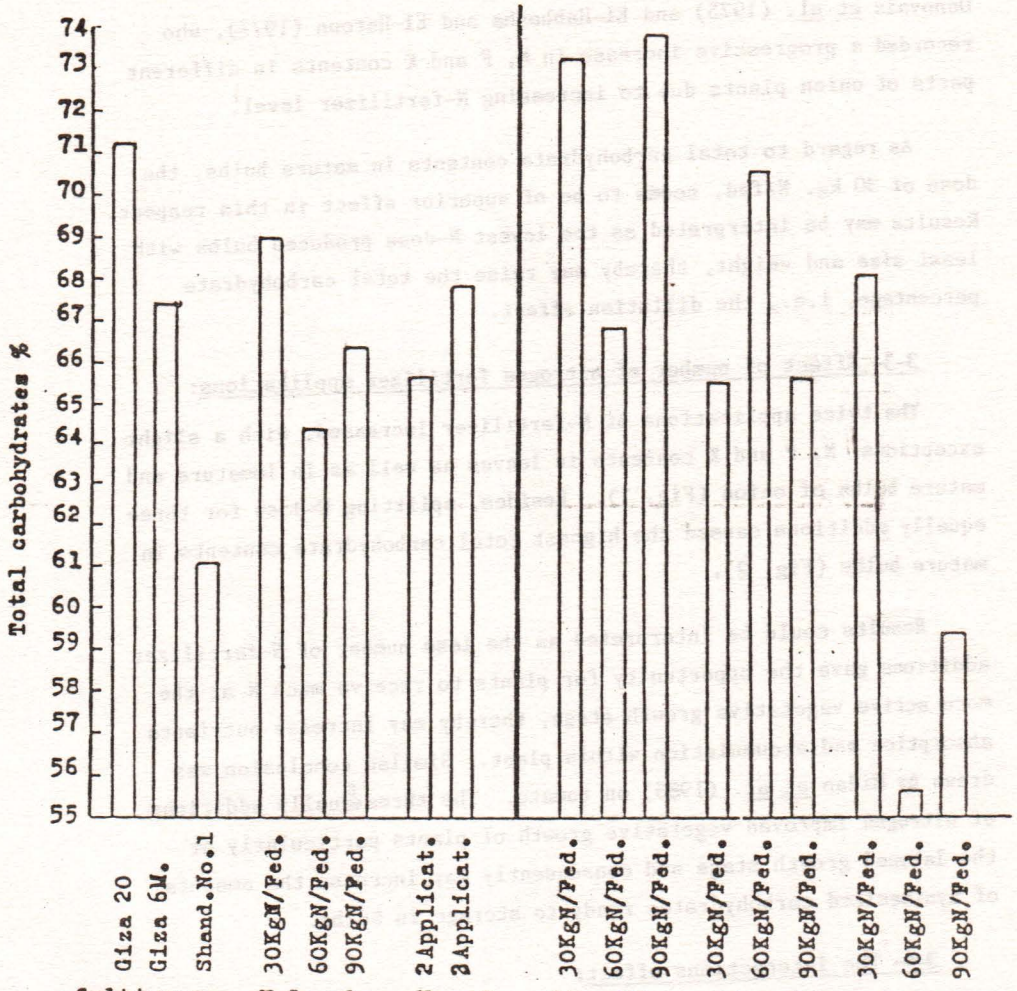

Fig.(2).Effect cultivars and N-fertilizer level along with its number of applications on total carbohydrate contents in mature onion bulbs.produced from 1984/1985 planting .

The interactive effect of cultivars and applied N-fertilizer level on total carbohydarate contents in mature onion bulbs.produced from 1984/1985 planting .

Denovais et al. (1975) and El-Habbasha and El-Haroun (1977), who recorded a progressive increase in N, P and K contents in different parts of onion plants due to increasing N-fertilizer level.

As regard to total carbohydrate contents in mature bulbs, the dose of 30 kg. N/fed. seems to be of superior effect in this respect. Results may be interpreted as the lowest N-dose produced bulbs with least size and weight, thereby may raise the total carbohydrate percentage, i.e., the dillution effect.

3-3- Effect of number of nitrogen fertilizer applications:

The twice applications of N-fertilizer increased, with a slight exceptions, N, P and K contents in leaves as well as in immature and mature bulbs of onion (Fig. 1). Besides, splitting N-dose for three equally additions caused the highest total carbohydrate contents in mature bulbs (Fig. 2).

Results could be interpreted as the less number of N-fertilizer additions gave the opportunity for plants to receive much N at the more active vegetative growth stage, thereby may increase nutrients absorption and accumulation within plant. Similar conclusion was drawn by Midan et al. (1985) on tomato. The three equally additions of nitrogen improved vegetative growth of plants particularly at the latened growth stage and consequently may increase the amounts of synthesized carbohydrates ready to storage in bulbs.

3-4- The interactions effect:

3-4-1- Cultivar x N-level:

Excepting for P content in leaves of Giza 6 M, nitrogen fertilizer applied at the dose of 60 kg./fed. caused the highest N, P and K contents in leaves of all tested cultivars (Fig. 3). The dose of 60 kg. N/fed. seemed also to be of superior effect on N and P

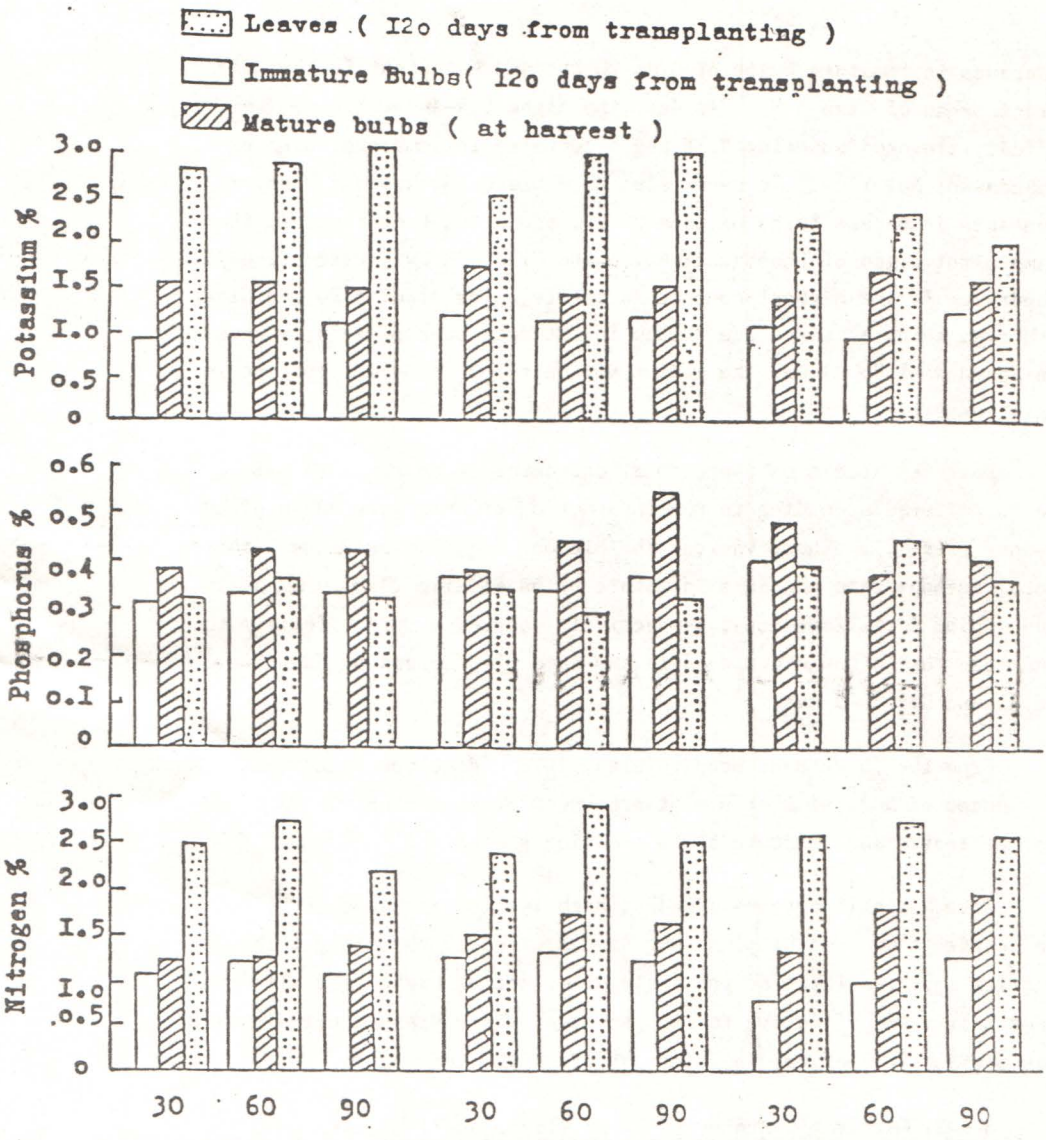

Fig. (3). The interactive effect of cultivars and applied nitrogen fertilizer level (kg N/fed.)on N,P and K contents in onion plants grown in 1984/ 1985 season .

contents in immature bulbs of Giza 20 cv. and N content in the same plant organ of Giza 6 M. Besides, the highest N-dose, i.e. 90 kg N/fed., provoked superior N, P and K contents in immature bulbs of Shandaweel No. 1 cv. It seems also to achieve the highest N and P contents in mature bulbs of Giza 20 cv. and N and P contents in the same plant organ of Shandaweel No. 1 and Giza 6 M cv., respectively. Regarding K, its highest content in mature bulbs of Giza 20 and Giza 6 M cvs. being obtained due to the lowest dose of applied N, whereas in Shandaweel No. 1 cv. the medium N-dose approved more effective in this respect.

Data revealed also that, total carbohydrate contents in mature bulbs differed according to the interaction of cultivars and applied N-dose (Fig. 2). Thus, whereas the highest N-dose caused the highest total carbohydrate contents in mature bulbs of Giza 20 cv., the lowest and medium fertilizer dose, respectively, approved more effective to increase this organic compound in the same plant organ of Shandaweel No. 1 and Giza 6 M cvs.

From the above mentioned results, it could be concluded that low doses of N-fertilizer are of prnounced effect on nutrients content of leaves and immature bulbs of onion plants.

When N-fertilizer was added at high levels, its superior effect on nutrients content of plant organs was extended to mature bulbs. Results appeared logic as the residual effect of higher fertilizer dose maintained effective for longer time. This drawn conclusion was previously confirmed by Midan et al. (1985) on tomato.

3-4-2- Cultivar x number of N-fertilizer applications:

As it can be seen from Figs. (4&5), the equally twice additions of N-dose seem to be, with some descrepancies, of superior effect on N, P and K contents in leaves as well as in immature and mature bulbs

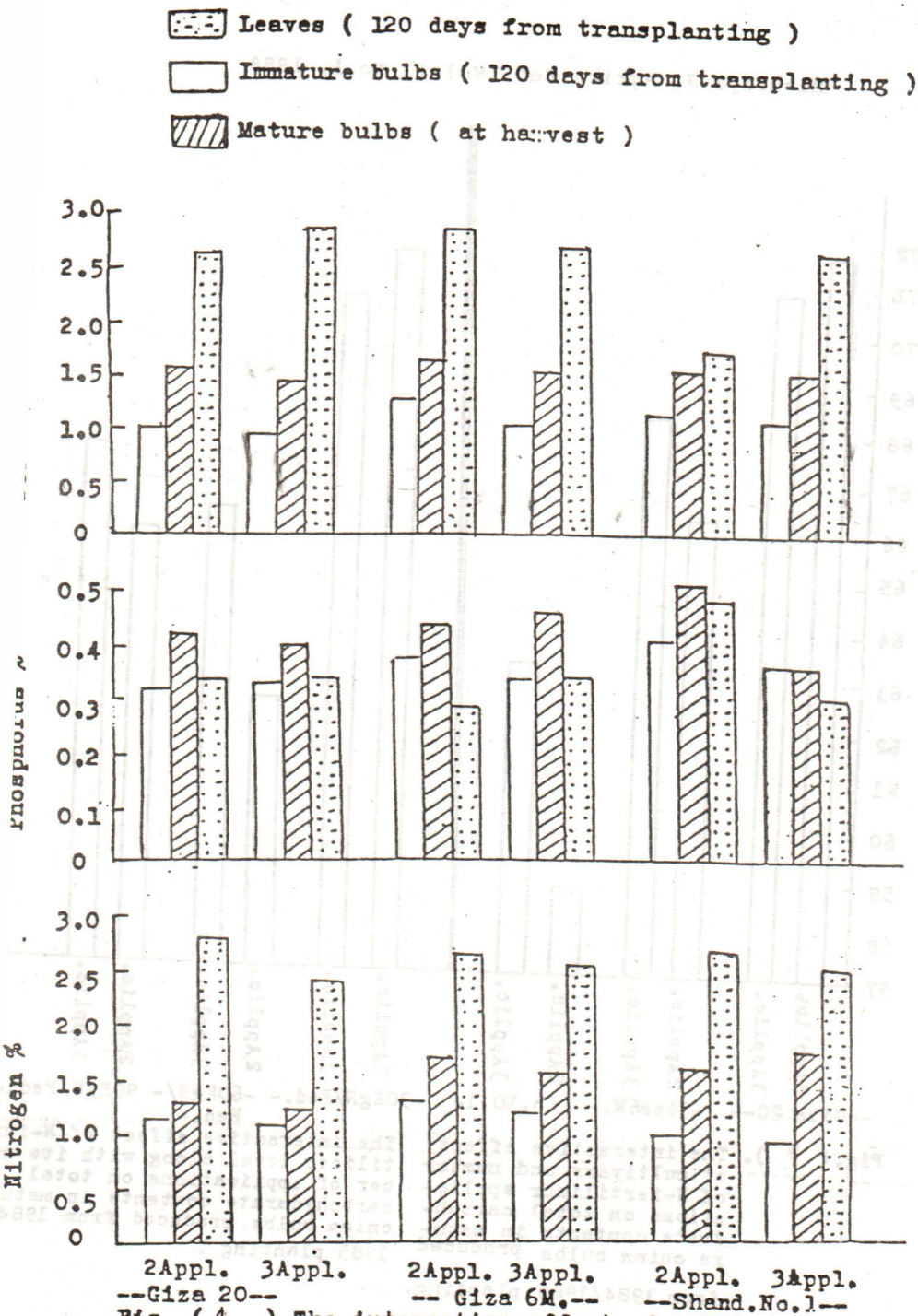

Fig. (4).The interactive effect of cultivars and number o nitrogen fertilizer applications on N,P and K contents in onion plnts grown in 1984/1985 season .

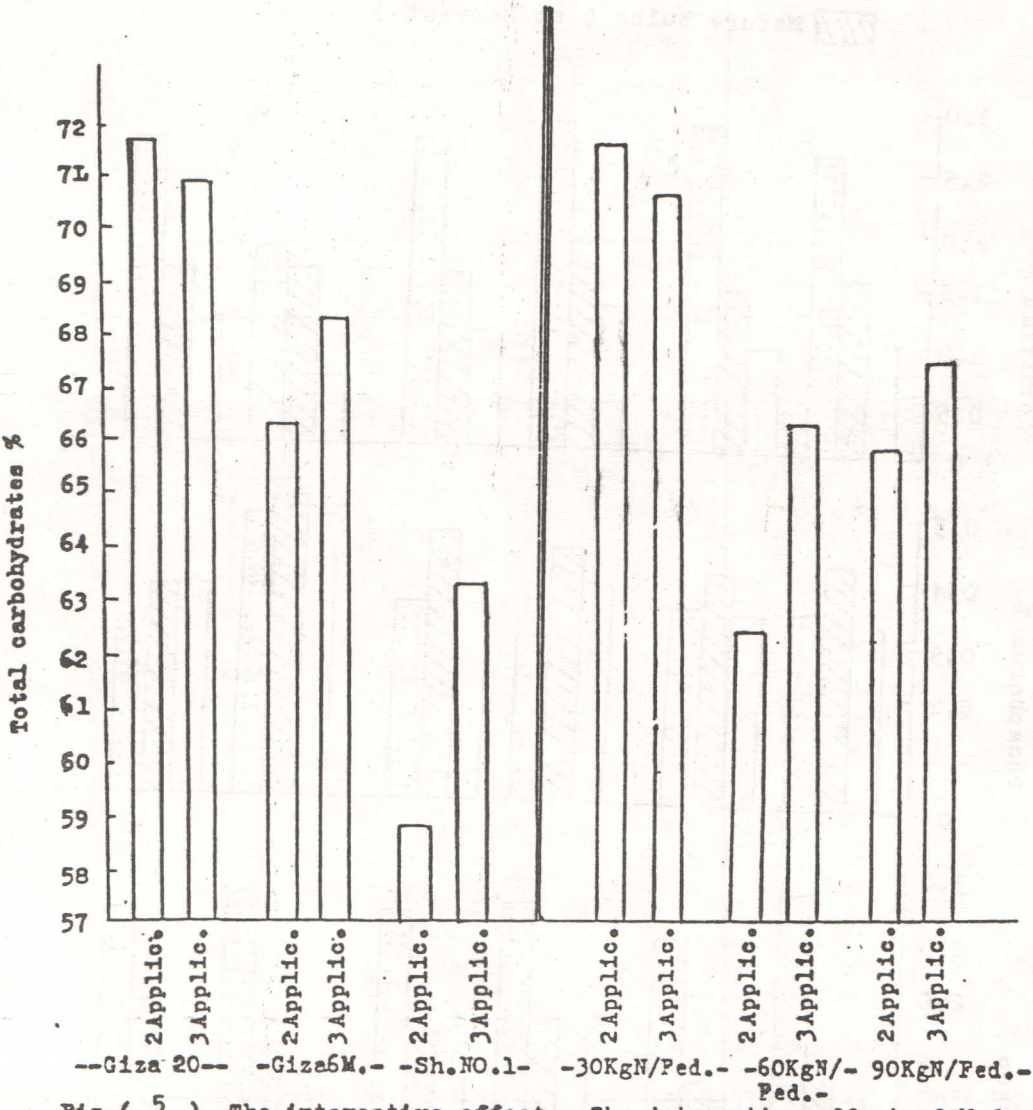

Fig.(5). The interactive effect of cultivars and number of N-fertilizer applications on total carbohdrate contents in mature oninn bulbs produced from 1984/1985 planting.

The interactive effect of N-fertilizer level along with its nuber of applications on total carbohydarate contents in mature onion bulbs produced from 1984/1985 planting .

of all studied cultivars. The twice N-fertilizer applications exerted also the highest total carbohydrate contents in mature bulbs of Giza 20 cv., whereas in Giza 6 M and Shandaweel No. 1 cvs. splitting N-dose for three equally additions approved more superior. Results may be explained as the further splitting of N-dose, i.e. three additions, prolongate vegetative growth period in such cultivars and consequently gave the opportunity for more carbohydrate accumulation in mature bulbs.

3-4-5- N-level x number of N-fertilizer applications:

The 60 kg. N/fed. dose seems to cause, irrispective its number of applications, superior N, P and K contents in leaves and immature bulbs of onion. In mature bulbs, 90 kg. N/fed. achieved the highest N and P content, whereas the highest K being obtained due to 60 kg. N/fed. Again, the twice additions of N-fertilizer, irrispective its dose, generally improved N, P and K contents in onion leaves as well as immature and mature bulbs. Besides, the twice additions of 30 kg. N/fed. gave the highest record of total carbohydrate contents in mature bulbs, whereas those of 60 kg. N/fed. being of lowest record. In this connection, splitting the medium and highest N-dose, i.e., 60 and 90 kg. N/fed. into three equally additions was observed to increase total carbohydrates in mature bulbs as compared to the twice additions of either dose (Figs. 5 & 6).

As compared to the less number of additions, the further splitting of the highest N-dose was observed also to achieve the highest N in leaves and immature bulbs and K in leaves only. Results may be explained as further splitting of the higher N-dose increase its efficiency of utilization by plants. This drawn conclusion was previously suggested by Midan (1972).

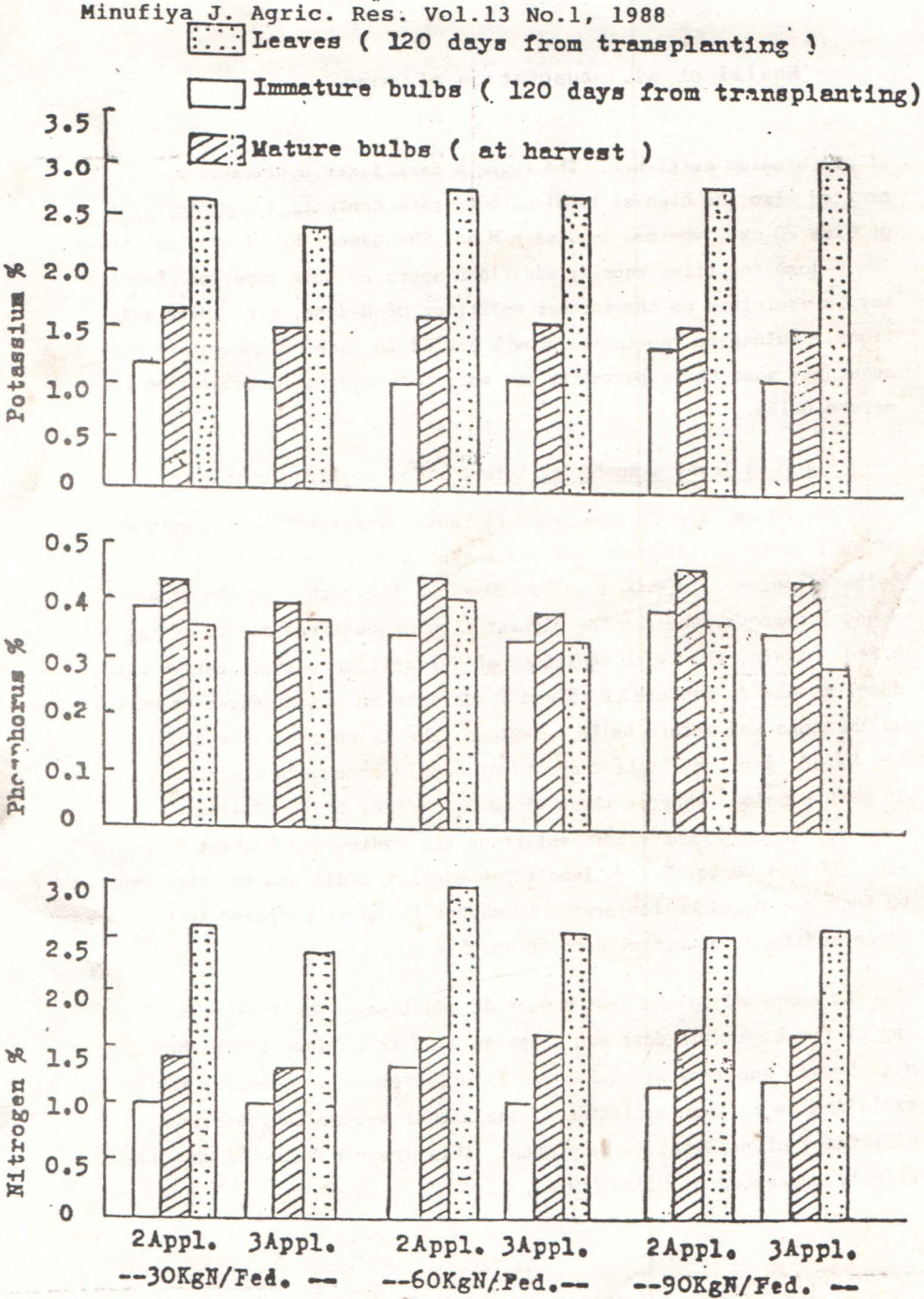

Fig. (6). The interactive effect of nitrogen fertilizer level along with its number of applications on N,P and K contents in onion plants grown in 1984/1985 season .

3-4-4- Cultivar x N-level x number of N-fertilizer applications:

The three factors combined effect seemed to exert neglible variations in chemical constitutents of different plant organs, so its related data were ommitted.

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