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الملخص العربى

دراسه مقارنه على تأثير فترات تخزين بارد مختلفه على ثلاثه أصناف تجاريه من الايريس

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الحديقه النباتيه بقصر القبه الحديقه النباتيه بالاورمان
معهد بحوث البساتين ، مركز البحوث الزراعيه ، وزاره الزراعه

أجريت الدراسه بمشتل الحديقه النباتيه بقصر القبه خلال موسمى الزراعه (١٩٨٣/ ١٩٨٤ ، ١٩٨٤/١٩٨٥) لدراسه تأثير فترات تخزين بارد مختلفه على درجه حراره الصفر المئوى للمدد (١٥ ، ٢٠ ، ٢٥ ، ٣٥ ، ٤٥ يوما) مقارنا فى ذلك بالتخزين العادى على درجه حراره الغرفه العاديه على ثلاثه أصناف تجاريه من الايريس (الايديال ذو الازهار الزرقاء ، جولدن هارفزت ذو الازهار الصفراء ، بريل سنساشن ذو الازهار البنفسجيه) .

أثبتت النتائج أن الاصناف الثلاثه من الايريس تختلف اختلافا واضحا من حيث نموها وانتاجها من الازهار والابصال وأيضا بالنسبه لمدى استجابتها للتخزين البارد وعلى أى حال أدى التخزين البارد بفتراته المختلفه الى دفع الازهار مبكرا عن الازهار الناتج من الابصال التى خزنت على درجه حراره الغرفه العاديه ، مما كان له أكبر الاثر فى امداد موسم ازهار الاصناف الثلاثه خلال الشتاء .

بينما أدى التخزين البارد الى خفض سمك السلاح الزهرى ووزنه الطازج ، كان له أثرا ظاهرا فى زياده مده حفظ الازهار الناتجه فى الزهريات .

أما بالنسبه لانتاج الابصال والبصيلات للاصناف الثلاثه فلم تتأثر مطلقا بمعاملات التخزين المختلفه .

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محروس / / :

FERTILIZATION OF SUMMER CARA POTATO VARIETY

By

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ABSTRACT

Two summer experiments 3^3 were conducted during 1986 and 1987, using Cara potato variety. Three levels of each of nitrogen, phosphorus and potassium fertilizers were used. Results of this study indicated that none of the studied factors had any sound effect on either plant stand or number of stems per plant. Potato tuber yield and the percentage of seed sized tubers were greatly affected by either nitrogen or potassium levels, while phosphorus was with minor effect. Some interaction effects were noticed among nitrogen, phosphorus and potassium levels on tuber yield. The combined effect of the levels of both nitrogen and phosphorus significantly affected the seed sized tuber percentage. Marketable tubers were affected by the growing season, and the levels of each of nitrogen and potassium fertilizers. Significant interaction effects were noticed between nitrogen and phosphorus levels to modify marketable tubers. Potato tuber dry matter was significantly affected by either nitrogen or potassium levels or by the combined effect of both.

While high levels of nitrogen resulted in great losses in tuber weight and early sprouting under nawwala storage conditions, potassium gave the opposite reaction. Phosphorus effect on stored tubers was lower than the other two elements.

It might be recommended that 225 Kg N, 45 Kg P_2O_5 and 156 Kg K_2O/Fad., could be used in fertilizing Cara potato fields. When the production of seed sized tubers is desired for seeding the following fall or winter (Meheyara) plantations, reducing the potassium level to 130 Kg K_2O/Fad. could be the best.

INTRODUCTION

Knowledge of fertilizer responses and optimum fertilizer levels for different soils in Egypt is essential to efficient potato production. The amount of fertilizers absorbed by potato plant differ from researcher to another. While Hawkins (1942) estimated the rate by 120-160 lb of nitrogen, 25-30 lb of phosphoric acid and 200-250 lb of potassium, Carpenter (1963) estimated it by 100-125 pounds of phosphoric acid and 150 pounds of potassium per hectar. Rates of N:P_2O_5:K_2O of 1:1.5:1 or 1:2:1 were suggested by Chamberland and Scott(1968).This balance would be satisfactory by the formula 8-12-8, the rate of application might range from 800 to 1200 pounds per acre. In Canada Flution and Findlay (1964) recommended the application of 1600 pounds per hectar of 5-10-13 fertilizer which gave the maximum yield with irrigation. The general recommendation for fertilizing potatoes in

eastern Virginia has been to apply 100 pounds per acre of each N, P_2O_5, K_2O on bands at planting in the non-irrigated soils. On the other hand in irrigated soils, the rates were sharply increased to reach 750-1000 pounds per acre to obtain the highest potato yield, as demonstrated by Dunton (1967). Recently, in Behiera, Egypt, El-Gamal (1985-a) obtained the highest Cara potato yield in clay loam soil by using 285 Kg N/Fad., when P_2O_5 and K_2O levels were 93 and 72 Kg/Fad. respectively. When either level, 104, 130 or 156 Kg K_2O/Fad. was used he (El-Gamal, 1985-c) gained the highest Cara potato yield when N and P_2O_5 levels were 200 and 93 Kg/Fad., respectively. Moreover, the same auther (El-Gamal, 1985-b) obtained the maximum yield from the same variety when 75 Kg P_2O_5/Fad. was used, through it was not significantly different from the level 60 Kg P_2O_5/Fad., when the rates of N and K_2O were 200 and 72 Kg/Fad., respectively.

El-Gamal (1985-a) did not find any effect of the increased N level up to 285 Kg N/Fad., on either plant stand or number of stems per plant as agreed also by Benepal (1967). Number of stems per plant was significantly affected by either P or K levels, increasing either one level raised the number of stems per plant as detected by El-Gamal (1985, b,c).

Total potato yield generally increases as N level increases. Ohms (1961), Hanley et al (1965), Benepal (1967) and El-Gamal (1980 and 1985-a). The worse side of such an increase in yield is the formation of high percentage of malformed tubers as observed by Ohms (1961) and Painter and Augustin (1967). Many authers indicated an increase in potato tuber yield as a result of increasing potassium level, such as Zandestra et al. (1969) and El-Gamal (1985-c). Although phosphorus was shown to increase total tuber yield as found by Benepal (1966), Leughlin (1974) and El-Gamal (1985-b), its role was not consistent in Benepal's (1967) experiments.

Potato tuber size was found to be greatly influenced by the fertilizers rates applied to the plants. El-Gamal (1985 a,b,c) found that the increased levels of either N, P or K reflected a significant reduction in seed sized tubers percentage. Likewise, Laughlin (1966) found that K application improved U.S. No. 1 tuber yield (Large sized tubers).

Nitrogenation of potato crop in an increasing manner was found to reduce the tuber dry matter, Painter and Augustin (1976) and El-Gamal (1980). Although K effect was similar to that of N on the tuber dry matter in Laughlin (1966) experiments, El-Gamal (1980 and 1985-c) found the opposite effect, increasing K level raised the tuber dry matter.

As for potato tubers storability Van Hiele (1961) claimed that the high N doses seemed to hasten sprouting as a result of high amids content. El-Gamal (1980) found that high levels of N resulted in an early sprouting of the nawwala stored tubers and a greater weight loss. Whitehead et al. (1953) stated that with the high doses

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of P, the progeny tubers sprouted early. In contrast, El-Gamal(1980) found that K fertilization tended to improve the storability of potato tubers under nawwala conditions. Hofman (1957) detected a potassium depressing effect on the hydrolising enzymes in potato tuber.

This study was an attempt to find out the optimum combination of N-P-K levels for fertilizing Cara potato variety yielded by the previously mentioned results obtained by the auther (El-Gamal, 1985 a, b and c) and to study the influence of the employed levels on the storability of the progeny tubers for the local market.

MATERIALS AND METHODS

Two summer season 3^3 experiments were conducted in El-Toud, Koom Hamada, Beheira governorate, Egypt, using Cara potato variety. The soil type of the sites used in both years was clay-loam, and their chemical analysis are shown in Table (1). Planting took place during the first week of January, while harvestings of the plots were done 115 days from planting, for both years, 1986 and 1987. The all possible combinations of nitrogen, phosphorus and potassium levels, employed in this study were; 195, 225 and 255 Kg N/Fad., in the form of ammonium sulphate (31.5%), 45, 60 and 75 Kg P_2O_5/Fad., in the form of triple superphosphate (46.5%), 104, 130 and 156 Kg K_2O/Fad. in the form of potassium sulphate (48%), were used. All the three fertilizers quantities calculated for each treatment were composed and added once at planting time to the opened rows.

A split-split plot in randomized complete block design, using 4 replicates, was arranged. The main plots were used to test the effects of nitrogen levels, while the sub-plots were devoted to investigate the effect of phosphorus. The sub-sub plots were employed to test the effects of potassium levels. Each plot (17.75 m^2) consisted of 4 ridges (0.71x6.25 m). One hundred imported out seed tubers were planted 25 cm apart.

Plant stand was recorded 45 days after planting, 15 days later the number of stems per plant was counted. At harvesting time, tuber yield was weighed, graded and the seed sized tubers (30-60 mm)portion was assessed for each plot. The malformed, cut, cracked, damaged, roted and heavely feathered tubers were excluded from the yield, and the rest was weighed (the marketable portion of the crop). At the mean time a random tuber sample (about 0.5 Kg) was taken from each plot for dry matter determination in 1986 experiment. Another sample (4 Kg) was taken in the same year from each plot fertilized with the three levels of the nutrients used, while the other two fertilizers were consistent at the moderate levels used, making 9 samples from each replicate for storage studies. Samples were put in net plastic bags each, dusted with D.D.T. 10%, weighed and randomly distributed in a nawwala. Potato bags were weighed every 15 days and the number of sprouted tubers (when the apical sprout reached 2 mm long) were counted over a period of 60 days after the commence of the storage experiment.

Table 1- Chemical analysis of the employed soil in the experiments in 1986 a
1987 summer seasons (Using the methods of analysis discribed by Bla
1965).

Years	S.P*	EC.e** mmhos/cm	pH	Cations, me/L				Anions, me/L				SAR***
				Na^+	K^+	Ca^{++}	Mg^{++}	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	
1986	71.3	3.2	8.11	3.6	0.93	25.60	12.41	0	4.13	14.31	28.43	0.
1987	70.5	3.0	8.12	3.1	0.89	20.22	9.35	0	4.02	13.22	29.30	0.

* S.P. = Saturation percentage
** ECe = Electric conductivity in soil extract.
*** SAR = $Na \Big/ \sqrt{\frac{Ca + Mg}{2}}$

The collected data was tabulated and the combined analysis of the two studied years was practiced. Cultural practices such as cultivation, milling, insect and disease control were similar to commercial practices in the area.

RESULTS AND DISCUSSION

Potato plant stand percentage as well as the average number of stems per plant were not affected by any of the studied factors, as shown in Table 2. These results indicate that both the seed tuber quality and the environmental factors of both years in this study were nearly similar.

Table 2- Effect of the year of production, N-P-K levels on plant stand perce
tage and the average number of stems per plant*

	Nitrogen levels			Phosphorus levels			Potassium levels			Years	
	Kg N/Fad.			Kg P_2O_5/Fad.			Kg K_2O/Fad.				
	195	225	255	45	60	75	104	130	156	1986	1
Plant stand %	97.0[a]	93.0[a]	94.0[a]	94.0[a]	96.0[a]	94.0[a]	96.0[a]	95.0[a]	93.0[a]	95.0[a]	9
Av.No.of stems/plant	2.3[a]	2.4[a]	2.3[a]	2.2[a]	2.4[a]	2.4[a]	2.4[a]	2.3[a]	2.2[a]	2.3[a]	

* See footnote of Table (3-A).

Table (3-A) shows that the total potato tuber yield is significantly affected by either N or K levels. The statistical highest yield was obtained when either moderate or high level of N (225 or 255 Kg N/fad) was used. The lowest yield was taken when the lowest level(195 Kg N/fad) was applied. The results agree with those obtained by Ohms

(1961), Hanley et al. (1965), Benepal (1967) and El-Gamal (1980 and 1985-a). Increasing the K levels used in this study resulted in an irreversible increase in potato yield. The significant greatest yield was obtained when the highest K level (156 Kg K_2O fad.) was used, and vice-versa. This result is in consistence with that of Zandstra et al. (1969) and El-Gamal (1985-c). Phosphorus fertilizer levels did not seem to affect the potato tuber yield as found also before by Penepal (1967). Alternatively, potato tuber yield was not affected by the year of production.

Table (3-A) Effect of the year of production, N-P-K levels and their interactions on total potato tuber yield (ton/fad.).

		Kg N/fad.			Kg P_2O_5/fad.			Kg K_2O/fad.			Mean
		195	225	255	45	60	75	104	130	156	
Year	1986	16.1[a]	18.4[a]	18.2[a]	17.4[a]	17.7[a]	17.7[a]	16.9[a]	17.5[a]	18.4[a]	17.6[A]
	1987	16.2[a]	18.1[a]	17.9[a]	17.2[a]	17.5[a]	17.5[a]	16.4[a]	16.9[a]	18.8[a]	17.4[A]
Kg N/fad	195	15.8[a]	16.2[a]	16.4[a]	14.7[a]	16.0[a]	17.8[a]	16.2[B]			
	225	18.1[a]	18.5[a]	18.3[a]	17.5[a]	18.2[a]	19.2[a]	18.3[A]			
	255	17.9[a]	18.1[a]	18.1[a]	17.9[a]	17.4[a]	18.9[a]	18.1[A]			
Kg P_2O_5/fad.	45				16.1[a]	16.5[a]	18.7[a]	17.1[A]			
	60				17.3[a]	17.9[a]	19.0[a]	17.6[A]			
	75				17.2[a]	17.4[a]	18.1[a]	17.6[A]			
Mean					16.7[C]	17.2[B]	18.6[A]				

* Values with an alphabetical letter in common, within a comparable group of means do not differ significantly from one another using Duncan's Multiple Range test at 0.05 level.

The only combined effect noticed to modify the potato tuber yield was that among N-P-K levels (Table 3-B). The highest Cara potato tuber yield resulted from the use of 225 Kg N, 60 Kg P_2O_5 and 165 Kg K_2O/fad although it was not statistically different from many other fertilizer combinations. It is clear from Table (3-B) that increasing either N or K levels or both of them found to favor the tuber yield production. The lowest potato yield resulted from the application of the lowest level of N-P-K, employed in this study.

Levels of N and K, the combined effect of K and year of production, and the interaction effect between N and P were found to affect the percentage of seed sized tubers (Table 4). The lower percentages of this category were obtained when either highest N or K levels were used. On the other hand, the highest percentage was gained when the lowest levels (195 Kg N and 104 Kg K_2O/fad.) were applied to the potato field plots

Table (3-B) Effect of N-P-K levels interactionson total potato tuber yield* (ton/fad.)

	Kg P_2O_5/fad.								
	195 Kg N/fad.			225 Kg N/fad.			255 Kg N/fad.		
	45	60	75	45	60	75	45	60	75
Kg . 104	14.4^{g}	14.3^{fg}	15.1^{fg}	17.0^{d}	17.7^{cd}	17.6^{cd}	16.9^{de}	17.4^{cd}	19.2^{ab}
P_2O_5/130	15.5^{efg}	15.7^{ef}	18.4^{abc}	18.1^{bcd}	18.1^{bcd}	18.5^{ab}	17.5^{ed}	17.7^{cd}	16.9^{bcd}
fad. 156	15.1^{fg}	16.9^{de}	17.2^{cd}	19.1^{ab}	19.5^{a}	19.0^{ab}	19.3^{ab}	19.2^{ab}	$18.1^{}$

* See footnote of Table (3-A).

Table 4- Effect of the year of production, N-P-K levels and their interactions on seed sized tubers percentage:

		Kg N/fad.			Kg P_2O_5/fad.			Kg P_2O/fad.			Mean
		195	225	255	45	60	75	104	130	156	
Year	1986	51.3^{a}	46.9^{a}	44.1^{a}	46.6^{a}	48.3^{a}	47.4^{a}	53.4^{a}	46.5^{b}	42.4^{c}	47.4^{A}
	1987	50.5^{a}	48.3^{a}	44.8^{a}	48.4^{a}	48.2^{a}	47.1^{a}	52.1^{a}	51.2^{a}	40.4^{bc}	47.9^{A}
Kg N/fad.	195				50.0^{ab}	52.0^{a}	50.8^{b}	55.8^{a}	56.7^{a}	45.3^{a}	50.9^{A}_{B}
	225				48.4^{c}	48.2^{c}	46.1^{d}	52.0^{a}	48.5^{a}	42.2^{a}	47.6^{C}
	255				44.1^{e}	44.5^{e}	44.8^{e}	50.3^{a}	46.4^{a}	36.7^{a}	$44.4^{}$
Kg P_2O_5/fad.	45							51.9^{a}	48.3^{a}	43.3^{a}	47.5^{A}_{A}
	60							53.8^{a}	49.8^{a}	41.0^{a}	48.2^{A}
	75							52.4^{a}	48.5^{a}	40.8^{a}	$47.2^{}$
Mean								52.7^{A}	48.8^{B}	41.3^{C}	

* See footnote of Table (3-A).

and inlargement, as mentioned by Lughlin (1966) who found that K increased U.S.A. No. 1 tubers (big size tubers), and El-Gamal (1985 a and c).

Potassium fertilizer levels showed some differences in their behaviour in the two studied years on the production of seed tubers. In 1986 experiment, decreasing K level resulted in a constant increase in seed sized tuber percentage. However, the two levels of 104 and 130 Kg K_2O/fad. were not significantly different fromeone another, in 1987 experiment.

As for the combined effect of N and P on the percentage of seed sized tubers, the highest percentage of this category of tubers was

obtained when 195 Kg N and 60 Kg P_2O_5/fad.were applied(Table 4). Modifying P level up or down at the low level of N (195 Kg N/fad) resulted in a significantly lower yield of seed sized tuber. With the moderated level of N (225 Kg N/fad.) the higheat level of P reduced the percentage of seed sized tubers. At the highest level of N (255 Kg N/fad.) the effect of P level was meaningless.

Year of production, levels of N and K as well as the interaction between N and P levels, were found to affect the marketable tuber percentage (Table 5). Potato grown during 1986 summer season produced larger percentage of marketable tubers than that grown during 1987 summer season. This result may be related to the efficiency of the harvesting processes during both years.

Table 5- Effect of the year of production, N-P-K levels and their interactions on the percentage of potato tubers marketable portion*.

		Kg N/fad.			Kg P_2O_5/fad.			Kg K_2O/fad.			Mean
		195	225	255	45	60	75	104	130	156	
Year	1986	89.6^{a}	88.6^{a}	85.8^{a}	88.3^{a}	87.7^{a}	88.1^{a}	83.8^{a}	81.6^{a}	88.2^{a}	88.0^{A}
	1987	88.1^{a}	87.0^{a}	81.5^{a}	85.9^{a}	84.9^{a}	85.8^{a}	85.1^{a}	92.0^{a}	89.3^{a}	85.5^{B}
Kg N/fad.	195				89.1^{a}	88.2^{a}	89.2^{a}	86.4^{de}	87.9^{cd}	92.2^{a}	88.8^{A}
	225				87.8^{a}	87.9^{a}	87.8^{a}	85.0^{e}	87.5^{cd}	91.0^{ab}	87.8^{A}
	255				84.3^{a}	82.8^{a}	83.8^{a}	76.8^{f}	84.5^{e}	89.5^{bc}	83.6^{B}
Kg P_2O_5/fad.	45							83.3^{a}	87.0^{a}	91.0^{a}	87.1^{A}
	60							81.5^{a}	86.1^{a}	91.1^{a}	86.3^{A}
	75							83.3^{a}	86.9^{a}	90.5^{a}	86.9^{A}
Mean								82.7^{C}	86.7^{B}	90.9^{A}	

*: See footnote of Table (3-A).

Increasing K level did not favor the production of marketable tubers (Table 5). Fertilizing cara plots with the lowest level of N (195 Kg N/fad.) produced more marketable tubers, though it was not significantly different from the moderate level (225 Kg N/fad.). This result might be related to the formation of malformed tubers, when high levels of N were used. This result is in agreement with those of Ohms (1961)and Painter and Augustin (1976). This may be due to the easy cutting, cracking,pealing of the tubers through the tough handling of the crop during the harvesting of the heavly nitrogenated plots, which produce tubers with high moisture content, as it is clear in Table 6.

The highest percentage of marketable tubers was harvested when the highest level of K (156 Kg K_2O/fad.) was used. Such an increasing effect may be counted for the effect of K on the formation of more dry tubers, as shown in Table 6. Well formed skin and more balanced relation between

the accumulation of starch and tuber moisture are also expected with the high level of K. As a result of this balance the formation of malformed tubers becomes rare.

Using the lowest level of N (195 Kg N/fad.) combined with the top level of K (156 K_2O/fad.) produced the highest percentage of the marketable tubers, although it was not significantly different from the combination of 156 K_2O and 225 Kg N/fad. In general, the higher K level reduced the undesirable effect of N in this respect.

Tuber dry matter is shown to be highly influenced by either N or K levels and their combined effect (Table 6). The progeny tubers resulted from heavely nitrogenated or lightly fertilized with K are characterized with lower contents of dry matter. The highest tuber dry matter was obtained when the lowest level of N or the highest level of K was used. These results are in agreement with these of Painter and Augustin (1976) and El-Gamal (1980 & 1985-c). When the lowest level of N was combined with the highest level of K the highest tuber dry matter was obtained. Reducing N level or increasing K level to the potato plants resulted in a considerable increase of the progeny tuber dry matter

Table 6- Effect of N-P-K levels and their interactions on potato tuber dry matter percentage, in 1986 summer season.

		Kg N/fad.			Kg K_2O/fad.			Mean
		195	225	255	104	130	156	
Kg P_2O_5/fad.	45	23.18^{a}	22.03^{a}	20.88^{a}	20.03^{a}	21.80^{a}	24.27^{a}	22.03^{A}
	60	23.05^{a}	22.16^{a}	21.03^{a}	19.90^{a}	22.15^{a}	24.18^{a}	22.08^{A}
	75	23.12^{a}	22.36^{a}	21.01^{a}	20.18^{a}	21.99^{a}	24.31^{a}	22.16^{A}
Kg N/fad.	195				20.98^{e}	23.33^{c}	25.04^{a}	23.12^{A}
	225				19.88^{fg}	22.35^{d}	24.33^{b}	22.18^{B}
	255				19.25^{g}	20.27^{f}	$23,39^{c}$	20.96^{C}
Mean					20.04^{C}	21.98^{B}	24.25^{A}	

* See footnote of Table (3-A).

Potato tubers resulted from heavily nitrogenated plants lost about 20% of their weight during the first 15 day of storage (Fig. 1-A). The weight loss reached about 35% after 60 days. In contrast the gently nitrogenated plants gave progeny tubers that hold better during the storage days. This high loss might be due to the high moisture content of the tubers and the late formation of the tuber skin of the progeny tubers of the heavely nitrogenated plants. On the other hand the highest level of K resulted in the lowest weight loss of the stored tubers (Fig. 1-C). Phosphorus seemed to have the minor effect on tuber weight loss during the nawwala. storage period, (Fig. 1-B) but

with an exception that the highest level of P resulted in a pronounced weight loss after 45 days of storage. This loss may be due to the direct effect of the tuber sprouting as clear in Fig. 2-C, in which the heavy P fertilizer resulted in an early sprout, after 30 days of storage.

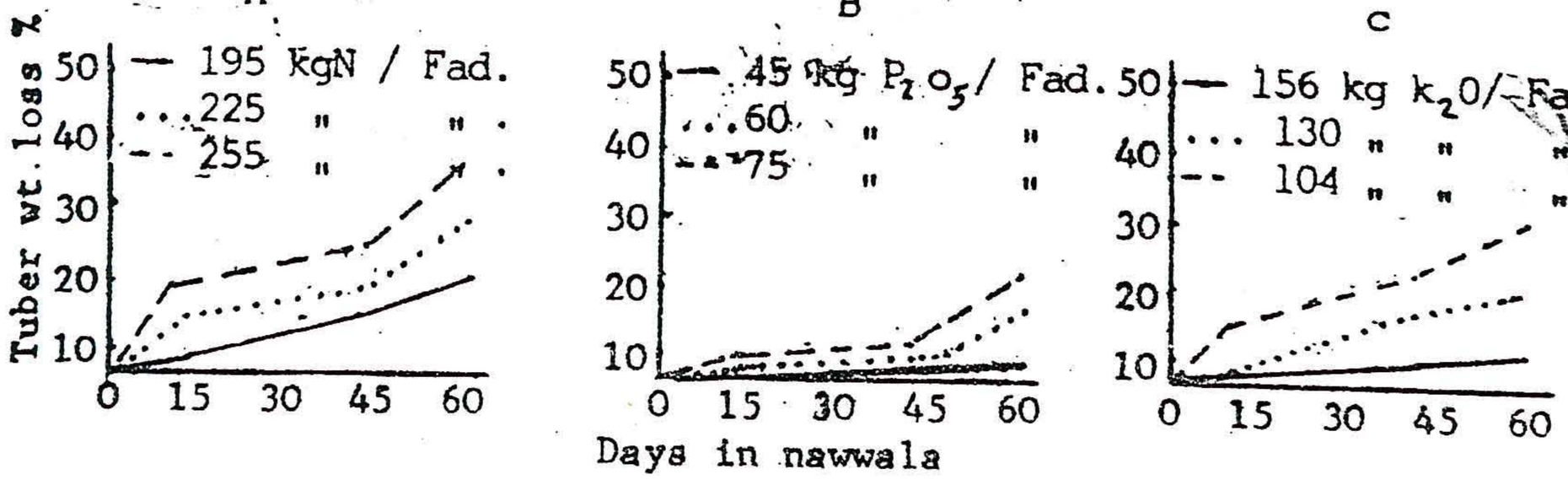

Fig. 1- Effects of N-P-K levels on the weight loss of potato tubers, stored under nawwala storage conditions during 1986 summer months.

Potato tubers harvested from heavely nitrogenated plants started to sprout earlier than the others (Fig. 2-A). With the lowest level of N (195 Kg/fad.) the progeny tubers sprouted 30 days later than the heavely nitrogenated ones. These results are in agreement with those presented by Van Heile (1961).

Potassium was found to alter the effect of N on the tuber sprouting e.g. it retarded tuber sprouting (Fig. 2-C). The first sprout was noticed after 45 days from storage with the lowest K level (Fig. 2-C). Applying heavy K level caused a light tuber sprouting after 60 days of storage. Phosphorus showed some accelerating effects on tuber sprouting (Fig. 2-B). The highest level of P (75 Kg P_2O_5/fad.)caused an early sprouting of the tubers, but not to the extent of N effect.

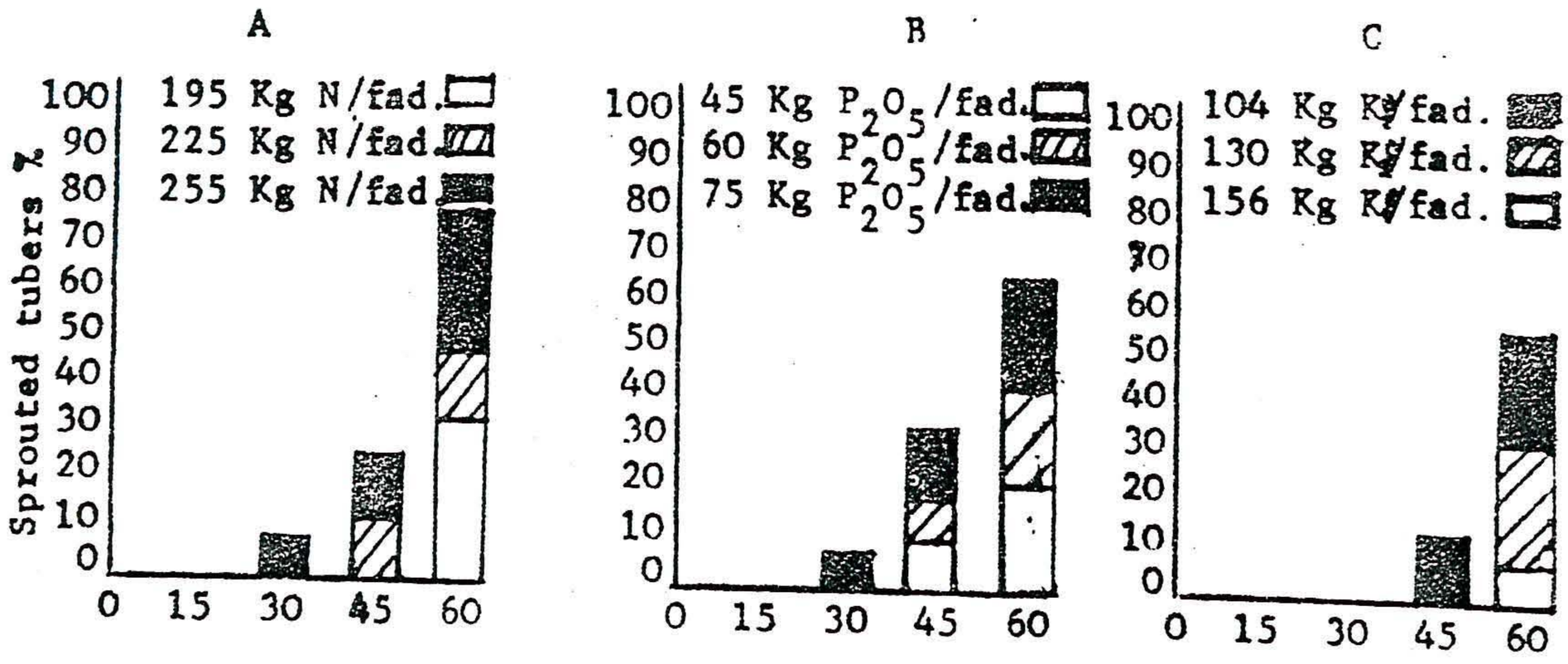

Fig. 2- Effect of N-P-K level on the sprouted potato tuber percentage stored under nawwala storage conditions during 1986 summer months.

It could be concluded from the results in this study that 225 Kg N, 45 Kg P_2O_5 and 156 Kg K_2O/fad. could be possibly used to fertilize Cara potato variety. When the production of seed sized tubers is desired, for seeding of the fall and winter (Mehayara) plantations, reducing the K rate to 130 Kg K_2O/fad. is also recommended.

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