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EFFECT OF BIO-FERTILIZER NITROBEIN AND MINERAL NITROGEN FERTILIZER LEVELS ON GROWTH AND PRODUCTIVITY OF SWEET POTATO PLANT

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ABSTRACT

Two field experiments were conducted during 1997 and 1998 seasons at the Hort. Res Farm of Seds, Beniswef Govrenorate to investigate the effect of partially substituting of N fertilizer with the biofertilizer nitrobein on growth, yield and chemical constituents of two sweet potato cultivars (Mabrouka and South Africa). Each cultivar received four treatments including the control one, 30.75 kg N/fed(100%N). The other three treatments included soil inoculation with the biofertilizer Nitrobein combined with N fertilizer at rates of 23.06(75%N), 15.38(50%N) and 7.69(25%N) kg N/fed. The biofertilizer (Nitrobein) was supplied at the rate of 7kg/fed.

Results showed that, cv. Mabrouka had longer vine length and higher fresh weight of foliage per plant than South Africa during 1998.On the other hand, South Africa showed greater leaf area than Mabrouka during 1997.Moreover, data indicated that 50 and 25 % of N+ Nitrobein resulted in lower DWT% of leaves as compared with the control treatment (100%N).

Concerning total yield of tuber roots, no significant difference was observed between the two cultivars in 1997. While in 1998 cv. Mabrouka exceeded South Africa by about 39%.Results also showed that applying Nitrobein with 50 and 25% of N fertilizer gave the highest yield as compared with the control during the two growing seasons. They exceeded it by 12.6 and 10.8% during (1997) season and by 24.2 and 26.7% during 1998 season, respectively.

No significant differences were observed in the marketable yield between the two cvs. during the two growing seasons. Data also showed that 75% followed by 50%of N+ Nitrobein gave the highest values of marketable yield as compared with the control treatment (100%N).The lowest marketable yield during the two growing seasons was always given by the treatment 25% N+ Nitrobein.

Differences in average tuber root weight (g), DWT% and shape index of the tuber root were significant only during the second season . Mabrouka cv. had the highest of shape index of the tuber root. Also, it was obvious that 50%N+ Nitrobein resulted in the highest average weight of tuber root .On the other hand, the highest shape index and DWT % values resulted from 25% N+ Nitrobein .

Mabrouka showed higher percentages of N, P, K, protein and sugars than South Africa. However, fertilizer treatments had no influence on N, P and protein percentages of tuber roots. Potassium % was higher in tuber root received 50 or 25 %N+ Nitrobein as compared with control (100 % N). On the other hand, plants received 100 %N without Nitrobein produced tuber roots with 15.3 % and 11.4% sugar contents higher than those treated with 50 and 25 % of the recommend amount of nitrogen, respectively.

INTRODUCTION

Sweet potato (*Ipomoea batatas*, L) as a crop combines a number of advantages which give it an exciting potential role in combating the food shortages and malnutrition that may increasingly occur as a result of population growth and pressure on land utilization. It is considered as a cheap food source of carbohydrates, vitamins and mineral salts. Moreover, it can be also used as an animal fodder and starch making. Supplementing or substituting the inorganic N with organic sources become so urgent to overcome the problems of chemical fertilizers which resulted in increasing total cost of production as well as, environmental pollution. El Hadad *et al.* (1993) declared that biofertilizer application is considered a promising alternatively for chemical fertilizers under local conditions. Many studies pointed out that inoculation of sweet potato plants with N-fixing bacteria, (Azotobacter and Azospirillum) advanced both shoot growth and tuber root yield (Crossman and Hill, 1987;Kandasamy *et al.*1988; Khasa *et al.*1992; Paula *et al.* 1992; Yassin *et al.*1994 and Dawa *et al.*2000). On the other hand, Mortley and Hill (1990) mentioned that Azospirillum (AZP) inoculation did not enhance foliage of sweet potato when it was applied to soil with low to moderately high available N levels. Similarly, inoculation sweet potato plants with (AZP) and given 1/3 N fertilizer, produced vine growth and leaves similar to or even higher than the plants given normal rate of N fertilizer (Saad et al, 1999).

The objective of this work was to study the effect of partial substation of chemical N fertilizer by biofertilizer (Nitrobein) on plant growth, yield and chemical constituents of foliage and tuber roots of two sweet potato cultivars.

MATERIALS AND METHODS

Two field experiments were carried out at the Horticulture Research Farm of Seds, Beniswef Governorate during the two successive growing seasons 1997 and 1998. The objective of this work was to clarify the effects of partial substitution of chemical N fertilizer by the biofertilizer (Nitrobein) on growth , yield and chemical contents of tuber roots of the two sweet potato culivars Mabrouka and South Africa. Cuttings transplanted on 27 and 18 of May in 1997 and 1998, respectively. Mechanical chemical analysis and the bulk density of the different layer of the experimental area are shown in Table (1).

Table (1): The mechanical analysis and the bulk density of the different layers of the experimental area

Depth cm	Coarse sand%	Fine sand%	Silt %	Clay %	Texture class	Organic mater %	$CaCo_3$	Bulkdensity gm/cm^3
(0-15)	4.67	15.96	18.5	60.48	Clayey	5.50	3.50	1.10
(15-30)	4.50	13.50	19.0	63.00	Clayey	5.00	4.00	1.09
(30-45)	4.90	14.00	18.6	62.50	Clayey	2.00	3.90	1.15
(60-45)	3.50	15.50	16.0	65.00	Clayey	2.00	3.50	1.15

Experimental work:

Nitrobein (a commercial name in Egypt) is a biofertilizer containing live cells of efficient bacteria strains for N-fixation in cultivated soil was used .It was supplied by General Organization for Agriculture Equalization Fund (G.O.A.E.F), Ministry of Agriculture Egypt.

Two factor randomized complete block designs with 4 replicates was used. The plot area was 8.4 m2 contained 3 rows of 3.5-m length and 0.7-m width. Stem cuttings of 25 cm in length were planted at distance of 0.5 m within rows. Each cultivar received four treatments including the control one, which received 30.75 kg N/fed (100%of the recommended dose). The other three treatments included soil inoculation with the biofertilizer Nitrobein combined with N fertilizer at rates of 23.06,15.38 and 7.69 kg N/fed. N fertilizer was applied in the form of Ammonium sulfate (20.5% N). While the biofertilizer (Nitrobein) was supplied at 7kg/fed mixed with wet soft soil (1:10 ratio) into the root absorption zone of the plant. Both N fertilizer and Nitrobein were applied in two equal portions after 4 and 8 weeks from planting. Phosphorus and potassium fertilizers were applied to all treatments at rates of 300kg/fed calcium super phosphate (15.5% P2O5) and 100kg/fed Potassium Sulfate (48% K2O). One third of the former fertilizer was applied during soil preparation, while the rest were added in two equal doses, 4 and 8 weeks after planting. Potassium fertilizer was added also in two equal dose after planting at the same time of both N and P fertilizers. All other cultural practices were followed according to the recommendations of the Ministry of agriculture The two experiments were harvested after 180 days from planting

Data recorded

A – Vegetative growth characters:

Random samples of 5 plants were taken from each plot 10 days before harvesting to determine the average foliage fresh weight (kg), vine length(m)/plant, leaf area(cm2) (fifth leaf from the top of the main stem) and DWT % in leaves.

B – yield and its components:

At harvest time, all tuber roots from each plot were weighted to calculate the total yield expressed as kg/plot or ton/fed as well as the marketable yield % for each plot.

C-Tuber root characters:-

The average weight of individual tuber root (g) was calculated according the following equation:

total weight of tuber roots /plot

total number of tuber roots /plot.

10 tuber roots from each treatment were taken at harvesting time to determine the average shape index (length (cm)/ diameter (cm)) of tuber root as well as their dry weight (DWT)%.

D – Chemical constituents of tuber roots:

Five uniform tuber roots from each treatment during the second season were cleaned, dried and ground to determine ,N ,protein ,P ,k and total sugars as follows:

- N % was determined according to Koch and McMeckin(1924).
- Protein % was determined according to Pregl (1945).
- Phosphorus % was determined according to Troug and Meyer (1939).

- Potassium mg/100 dry weight determined according to Brown and Lilleland (1946).
- Total sugars % was determined according to Smoggy (1952) and Nelson (1974).

All obtained data were statistically analyzed using MSTSTC software, and revised L.S.D test easy used to compare the differences between treatments(Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

A – vegetative growth characters

Data presented in Table (2), showed that plant foliage fresh weight (kg)in 1997, vine length (m)in1997, leaf area (cm2)in 1998 and DWT% were not significantly affected by the two cultivars. Mabrouka gave significant higher foliage fresh weights and longer vine length per plant in 1998. While South Africa showed higher leaf area than Mabrouka during (1997) season.

Regarding fertilizer treatments, these mentioned parameters expect DWT% of leaves during the two growing seasons were not significantly influenced by either fertilizer treatments, or by their interactions with cultivars . These results were in agreement with those obtained by Mortley and Hill (1990). They mentioned that (AZP) inoculation did not enhance foliage of sweet potato when it was applied to soil with low to moderately high available N levels. Similarly, Saad *et al.* (1990) found that inoculation sweet potato plants with (AZP)given 1\3 N fertilizer produced vine growth and leaves similar to or higher than plants given normal rate of N fertilizers. Other investigators indicated that soil Azotobacter (AZT) population increased with low rates of N fertilizer but it decreased at higher rates(Panigrahi and Behera (1993) on potato). This may indicate that N at rate 25% of the recommended dose combined with the biofertilizer (Nitrobein) was sufficient to give appropriate vegetative growth under the local condition of the experiment. This may be attributed to the beneficial effect of Nitrobein, which related to the enchancing effect of non-symbiotic N-fixing bacteria on morphology and / or physiology at the root system, which probably promoted the vegetative growth. Jagnow *et al.* (1991) And Noel *et al.* (1996) indicated that non symbiotic N-fixing bacteria. Azotobacter(AZT) and Azospirillum(AZP) strains produced adequate amounts of IAA and cytokinins which increased the surface area per unit root length and enhanced root hair branching with an eventual increasing in the uptake of nutrients from the soil. As for the DWT % of leaves, data in Table (2) indicated that N at rates of 50 and 25 % of the recommended N dose combined with Nitrobein showed less DWT% comparing with the control (100%). But no significant difference was observed between (75% of the recommended N +Nitrobein) and the control treatment during the two growing seasons.

The interaction effects between cultivars and fertilizer treatments on DWT% of leaves appeared to be significant only in the second season . Mabrouka cv. showed the lowest DW% of leaves with the treatment of 50 and

25% of the recommended N combined with Nitrobein comparing with the control one. South Africa showed the lowest value with (25% N + Nitrobein).

Table (2): Interactive effect of the biofertilizer nitrobein and nitrogen levels on some vegetative growth characters of the two sweet potato cultivars Mabrouka and South Africa during the two growing seasons of 1997 and 1998.

		1997				1998			
Cultivars	**Fertilizer treatment**	**Foliage FWT (kg)**	**Vine length (m)**	**Leaf area (cm2)**	**Leaf DWT%**	**Foliage FWT (kg)**	**Vine length (m)**	**Leaf area (cm2)**	**Leaf DWT%**
Mabrouka		1.12a	2.94a	18.5b	21.750a	1.97a	2.90a	19.8a	21.519a
South Africa		1.17a	2.69a	20.28a	21.442a	1.03b	2.52b	21.4a	21.831a
	100%N	1.20a	3.05a	18.50a	22.950a	1.83a	2.83a	19.5a	23.006a
	75%N+ Nitrobein	1.28a	2.94a	19.87a	21.800ab	1.81a	2.83a	20.3a	22.194ab
	50%N+ Nitrobein	1.05a	2.69a	19.00a	21.150bc	1.76a	2.69a	21.2a	21.206bc
	25%N+ Nitrobein	1.06a	2.59a	20.20a	20.483c	1.63a	2.49a	21.5a	20.294c
	100%N	0.99a	3.56a	16.80a	23.200a	2.10a	3.35a	17.0a	23.569a
Mabrouka	75%N+ Nitrobein	1.43a	2.90a	18.53a	22.300a	1.94a	2.92a	19.9a	22.394ab
	50%N+ Nitrobein	1.05a	2.63a	18.67a	20.600a	1.88a	2.76a	20.9a	18.869c
	25%N+ Nitrobein	1.02a	2.67a	20.00a	20.900a	1.99a	2.56a	21.3a	21.244b
	100%N	1.42a	2.54a	20.20a	22.700a	1.56a	2.32a	22.1a	22.444ab
South Africa	75%N+ Nitrobein	1.13a	2.98a	21.20a	21.300a	1.69a	2.73a	20.7a	21.994ab
	50%N+ Nitrobein	1.05a	2.76a	19.33a	21.700a	1.65a	2.63a	21.4a	23.544a
	25%N+ Nitrobein	1.10a	2.50a	20.44a	20.067a	1.28a	2.42a	21.6a	19.344c

B –Total and marketable yields:

Data in Table (3) indicated that there was no significant difference in total yield between the two cultivars during 1997, while in 1998, Mabrouka cultivar significantly exceeded South Africa by about 39%. This result may be due to appropriate fresh weight (FWT) of foliage produced by Mabrouka (Table 2) which in turn led to high yield.

Regarding the effect of fertilizer treatments, data in the same table also showed that applying Nitrobein with 50 or even 25% of the recommended N rate gave higher yield during the two growing seasons comparing with the control treatment. They exceeded it by 12.6 and 10.8% during (1997) season , and by 24.2 and 26.7% during (1998) season, respectively. These results coincide with those of Crossman and Hill, 1987, Kandasamy *et al.* 1988, Khasa *et al.* 1992; Paula *et al.* 1992; Yassin *et al.*

1994 and Dawa et al. 2000. They pointed out that inoculation sweet potato plants with (AZP or AZT) advanced tuber root yield. These results may be attributed to the greater DWT %Of leaves produced by the control treatment (Table2) indicating that higher N rate tended to increase DWT% of leaves on the expense of tuber root yield. These results were in-incidence with those of Bourke, (1985); Mascianica *et al.* (1985); Mishra *et al.* (1992); Marcano and Diaz, (1994) and Lee *et al.* (1996). They mentioned that most of sweet potato cultivars were generally reacting adversely to excessive N-level by yielding less.

Table (3): Interactive effect of the biofertilizer nitrobein and nitrogen levels on the total yield and the marketable yield % of the two sweet potato cultivars Mabrouka and South Africa during the two growing seasons of 1997 and 1998.

			1997			1998	
Cultivars	**Fertilizer treatments**	**Yield kg\plot**	**Yield ton\fed**	**Market Able Yield%**	**Yield kg\plot**	**Yield ton\fed**	**Marketable yield%**
Mabrouka		21.337a	10.16a	82.8a	25.50a	12.14a	86.7a
South Africa		20.569a	9.81a	84.7a	18.32b	8.68b	87.9a
	100%N	19.688b	9.38b	85.5c	19.13b	9.07b	85.4c
	75%N+ Nitrobein	20.138b	9.59b	90.7a	21.43b	10.16ab	94.1a
	50%N+ Nitrobein	22.175a	10.56a	85.6b	23.77a	11.27a	89.1b
	25%N+ Nitrobein	21.812a	10.39a	76.3d	23.30a	11.04a	80.6d
	100%N	20.475a	9.75a	80.0c	21.18a	10.04a	83.6cd
Mabrouka	75%N+ Nitrobein	20.575a	9.80a	87.5b	24.89a	11.85a	91.1b
	50%N+ Nitrobein	22.900a	10.91a	86.1b	27.45a	13.06a	91.1b
	25%N+ Nitrobein	21.400a	10.19a	77.5cd	28.47a	13.56a	81.0d
	100%N	18.900a	9.00a	85.0b	17.08a	8.13a	87.0c
South Africa	75%N+ Nitrobein	19.700a	9.38a	93.9a	17.97a	8.56a	97.0a
	50%N+ Nitrobein	21.450a	10.21a	85.0b	20.09a	9.57a	87.3bc
	25%N+ Nitrobein	22.225a	10.58a	75.0d	18.14a	8.64a	80.2d

As for the marketable yield data in the same table (Table 3) also showed that, no significant differences were observed between the two cvs. during the two growing seasons.

Concerning the effect of fertilizer treatments, data in (Table 3) showed that 75% followed by 50% of N fertilizer + Nitrobein gave the highest marketable yield % comparing with the control one. The lowest marketable yield % was always given by the treatment 25%N+nitrobein during the two seasons.

The interaction effect between cvs. and fertilizer treatments were significant during the two growing seasons. Mabrouka Showed the highest values with 75 and 50% of the recommended N dose + Nitrobein during the two growing seasons. They resulted in 87.5, 86.1 and 91.1, 91.1% during the two-growing seasons, respectively. South Africa produced the highest value when it was given 75% of N + Nitrobein, it produced 93.9 and 97.0% during the two growing seasons, respectively, comparing with the other treatments.

C-Tuber root characters:

Data presented in Table (4) indicated that the average tuber root fresh weight (g), as well as tuber root dry weight, were not significantly affected by the two cvs. during the two growing seasons with the exception of the shape index during the second season only, where cv. Mabrouka showed higher ratio than cv. South Africa .

Table (4): Interactive effect of the biofertilizer nitrobein and nitrogen levels on the fresh weight, shape index and dry weight of the tuber root of the two sweet potato cultivars Mabrouka and South Africa during the two growing seasons of 1997 and 1998.

Cultivars	Fertilizer treatments	1997			1998		
		Tuber FWT (g)	Shape index	Tuber DWT %	Tuber FWT (g)	Shape index	Tuber DWT %
Mabrouka		286.4a	2.99a	28.795a	290.0a	3.48a	29.781a
South Africa		343.1a	2.77a	28.139a	274.4a	2.91b	29.358a
	100%N	324.8a	2.90a	28.615a	279.3b	3.23b	28.221b
	75%N+ Nitrobien	345.0a	3.07a	27.868a	268.3b	3.02b	28.009b
	50% N+ Nitrobien	308.1a	2.73a	27.927a	319.9a	2.95b	29.274b
	25%N+ Nitrobein	281.3a	2.83a	29.457a	261.4b	3.59a	32.774a
Mabrouka	100%N	263.3a	2.81ab	28.993a	237.9b	3.30a	29.140a
	75%N+ Nitrobien	345.0a	2.92a	28.323a	310.9a	3.32a	28.280a
	50% N+ Nitrobien	270.0a	3.24a	28.147a	319.6a	3.27a	28.455a
	25%N+ Nitrobein	267.5a	3.01a	29.715a	291.7a	4.04a	33.248a
	100%N	386.3a	2.99a	28.237a	320.8a	3.16a	27.303a
South Africa	75%N+ Nitrobien	345.0a	3.22a	27.413a	225.7b	2.72a	
	50% N+ Nitrobien	346.3a	2.23b	27.707a	320.3a	2.63a	30.093a
	25%N+ Nitrobein	295.0a	2.64ab	29.200a	230.9b	3.14a	32.300a

Concerning the effect of fertilizer treatments data presented in the same table (Table4) also showed that the results were significant only during the second season . It is obvious that 50% of N fertilizer + Nitrobein resulted in the highest average weight of tuber roots .On the other hand, 25% of N fertilizer + Nitrobein gave the highest shape index and DWT % values.

Regarding the interaction effects, data in the same table(Table 4) also showed that the two cultivars were different in their responses. Mabrouka cv. produced the highest average weight of tuber root when it received 75 %of N fertilizers combined with the biofertilizer. While with South Africa, no trend was observed. With the shape index, Mabrouka showed the same trend of tuber root weight . On the other hand, South Africa indicated high significant values of shape index only in 1997 by the treatment of 75% N fertilizer + Nitrobein followed by the control one. As for DWT %,the interaction effects were not significant during the two growing seasons.

D- Chemical constituents of tuber roots:

Results in Table (5) indicated that cv. Mabrouka showed higher percentages of N, P, and K than South Africa. It expressed 1.22, 0.457 and 2.908 % of N, P and K ,respectively .Whereas South Africa showed 1.14 ,0.423 and 2.733 % of N,P and K ,respectively.

Moreover, Mabrouka cultivar produced tuber roots containing 7.01 % protein and 8.63 % total sugar concentrations higher than those produced by South Africa .

These differences could be due to the genetic differences between the two cultivars. Similar conclusion was reported by (Picha1985a).

Also, variability in total protein and sugar contents was notable among sweet potato cultivars from various regions (Jennifer, 1992).

Table(5)also showed that, fertilizer treatments did not affect N and P percentages of tuber roots, whereas potassium %was higher in tuber root received 25 and 50% of N+ Nitrobein comparing with other treatments .These results are in accordance with those of Abdel-Fatah *et al.* (2001). Findings showed that N and P contents of the tuber root were not affected by increasing N-rates from 0 to 80 kg / fed with biofertilizer applications. Whereas, K content increased with increasing the previous N rates with the biofertilizer application.

Protein content of the tuber roots was not significantly influenced by fertilizer rates as shown in Table (5). Opposite results were reported by Jadhav *et al.* (1998) on sweet potato. They found that protein content increased with increasing N rate and dual inoculation.

On the other hand, tuber root sugar content was significantly influenced by fertilizer treatments(Table5).Plants received100 % of N without Nitrobein produced tuber roots with 15.3 % and 11.4% higher in sugar concentrations than those treated with 50 and 25 % nitrogen, respectively. No significant differences were observed between 75 % of N + Nitrobein and the control one. In this aspect Jadhav *et al.* (1998) using 31.25 kg N / fed and un-inoculated or inoculated with AZT and or AZP, found that inoculation decreased sugars and increased starch levels.

Finally Table (5) showed also that the interactions between cultivars and fertilizer treatments had no significant effects on N, P, K, protein and sugar contents of the tuber roots .

Table (5): Interactive effect of the biofertilizer nitrobein and nitrogen levels on the chemical constituents of tuber roots of the two sweet potato cultivars Mabrouka and South Africa during the growing season of 1998.

Cultivars	Fertilizer treatments	N%	Protein%	P%	K%	Sugars%
Mabrouka		1.220 a	7.625 a	0.457 a	2.908 a	3.866 a
South Africa		1.140 a	7.125 a	0.423 b	2.733 b	3.599 b
	100%N	1.220 a	7.625 a	0.435 a	2.750 c	3.963 a
	75%N+ Nitrobein	1.010 a	6.312 a	0.445 a	2.750 c	3.894 a
	50%+N Nitrobein	1.120 a	7.000 a	0.440 a	2.817 b	3.438 b
	25%+N Nitrobein	1.330 a	8.312 a	0.440 a	2.967 a	3.556 b
Mabrouka	100%N Nitrobein	1.120 a	7.000 a	0.447 a	2.850 a	4.175 a
	75%N+ Nitrobein	0.960 a	6.013 a	0.452 a	2.850 a	4.125 a
	50%+N Nitrobein	1.250 a	7.813 a	0.463 a	2.917 a	3.400 a
	25%+N Nitrobein	1.510 a	9.438 a	0.466 a	3.017 a	3.763 a
South Africa	100%N	1.330 a	8.313 a	0.422 a	2.650 a	3.750 a
	75%N+ Nitrobein	1.070 a	6.688 a	0.439 a	2.650 a	3.663 a
	50%+N Nitrobein	0.990 a	6.188 a	0.416 a	2.717 a	3.475 a
	25%+N Nitrobein	1.140 a	7.125 a	0.414 a	2.917 a	3.350 a

CONCLUSION

It might be concluded that substituting the inorganic N fertilizer with the biofertilizer Nitrobein till 25 % (7.69kg N/fed)was sufficient to produce the highest tuber root yield. Whereas ,substituting 50%of N(15.38 kg N/fed)was quite enough to produce the highest marketable yield %of the two cultivars under investigation. This substituting of the inorganic N may help in over coming the problems of high prices of chemical fertilizers by decreasing the total cost of production as well as lowering environmental pollution.

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تأثير التسميد بالمخصب الحيوي النتروبين ومستويات من السماد النيتروجينى على نمو وإنتاجية نبات البطاطا

صــفاء على أحمد منصور
قسم بحوث البطاطس والخضر خضرية التكاثر
معهد بحوث البساتين – مركز البحوث الزراعية

أجرى هذا البحث في الموسمين الزراعيين ١٩٩٧، ١٩٩٨ بمزرعة بحوث البساتين بسدس محافظة بنى سويف لمعرفة تأثير استبدال أو إحلال المخصب الحيوي نترو بين بدلاً من السماد الكيماوي (النتروجين) على النمو ، المحصول والتركيب الكيماوي لصنفي البطاطا مبروكة وجنوب أفريقيا.
وكان تصميم التجربة القطاعات الكاملة العشوائية ذات العاملين فى أربع مكررات.
وكانت المعاملات لكل صنف كالآتي:
١) التسميد بالمعدل الموصى به من النتروجين ٣٠،٧٥ كجم /فدان بدون نترو بين(١٠٠%ن) .
٢) التسميد(٧٥%)من المعدل الموصى به من النتروجين ٢٣,٦ كجم ن / فدان+ نترو بين (٧٥% ن).
٣) التسميد(٥٠%)من المعدل الموصى به من النتروجين ١٥,٨٣ كجم ن/ فدان+نترو بين (٥٠% ن.
٤) التسميد٢٥% من المعدل الموصى به من النتروجين ٧,٦٩ كجم ن /فدان+نترو بين (٢٥%)
أضيف النتروجين في صورة سماد سلفات نشادر (٢٠,٥%ن) وأضيف النتروبين إلى المنطقة حول الجذور بمعدل ٧ كجم / للفدان حيث تم خلطه بتربة رطبة بمعدل (١:١٠) وتم إضافة الأسمدة والمخصب على دفعتين بعد أربعة وثمانية أسابيع من الزراعة وقد أظهرت النتائج ما يلي:-

١- التأثير على النمو الخضري:
تفوق الصنف مبروكة على الصنف جنوب أفريقيا في طول العرش ووزن المجموع الخضري في الموسم (١٩٩٨)بينما تفوق الصنف جنوب أفريقيا فى مساحة الورقة في (١٩٩٧) وبالنسبة لمعاملات التسميد فقد أعطى التسميد بمعدل ٥٠% ، ٢٥% من السماد الأزوتي بالإضافة إلى النتروبين نسبة أقل من الوزن الجاف للأوراق مقارنة بمعاملة الكنترول.

٢- التأثير على المحصول :
• لم تكن هناك فروق معنوية بين الصنفين في الموسم ١٩٩٧ بينما ظهر تفوق الصنف مبروكة في المحصول في الموسم الثاني حيث أعطى زيادة في المحصول تمثل ٣٩% بالمقارنة بمحصول الصنف جنوب أفريقيا.
• إضافة النتروبين مع ٥٠% + ٢٥% من التسميد النيتروجيني أدت إلى زيادة المحصول بنسبة ٦,١٢ ، ١٠,٨ % (١٩٩٧) ، ٢٤,٢ ، ٢٦,٧ % (١٩٩٨) مقارنة بالكنترول (١٠٠% نتروجين بدون مخصب حيوي) على التوالي.

• أعطى المعدل ٧٥%من السماد النيتروجيني + المخصب الحيوي يليه المعدل ٥٠% من السماد النيتروجيني + المخصب الحيوي أعلى نسبة للمحصول الصالح للتسويق بالمقارنة بالكنترول بينما أعطى المعدل ٢٥%من السماد النيتروجيني + المخصب الحيوي أقل نسبة للمحصول القابل للتسويق.
٣-التأثير على صفات الجذور الدرنية:
• بالنسبة للتأثير على صفات الجذور الدرنية فإن النتائج كانت معنوية في الموسم الثاني فقط ؛حيث أعطى الصنف مبروكة أعلى قيمة لمعامل الشكل. وكذلك ظهر من النتائج أن إضافة ٥٠% من السماد النتروجين + المخصب الحيوي نترو بين أعطت أعلى متوسط لوزن الجذور بينما أعطى المعدل ٢٥% السماد النيتروجيني + المخصب الحيوي أعلى نسبة لمعامل الشكل والمادة الجافة.

٤- التأثير على التركيب الكيماوي للجذور الدرنية:
أعطى الصنف مبروكة أعلى نتائج بالنسبة لمحتوى الجذور من النتروجين والفسفور والبوتاسيوم والبروتين والسكريات مقارنة بالصنف جنوب أفريقيا. وبالنسبة لمعاملات التسميد لم يكن هناك فروق بين المعاملات بالنسبة للنتروجين والفسفور والبروتين بينما أعطت المعدلات ٥٠% ؛٢٥% من التسميد بالنتروجين + النتروبين أعلى محتوى للبوتاسيوم مقارنة بالكنترول (١٠٠% ن).
بينما كان محتوى الجذور الدرنية التي سمدت بمعدل ١٠٠% نتروجين بدون مخصب من السكريات الكلية أعلى من المعاملات التي سمدت بالمعدلات ٥٠%،٢٥% من سماد النتروجين + المخصب الحيوي بمقدار ١٥,٣ ، ١١,٤ % على الترتيب.