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EFFECT OF N, P AND K, ON GROWTH, YIELD AND RESPONSE TO NEMATODE INFESTATION OF SOME FORAGE PEARL MILLET (*Pennisetum typhoides*) VARIETIES

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ABSTRACT

Two field trials were conducted at the Experimental Farm of Sers-Elliyan Agricultural Research Station, Menoufia Governorate, to estimate the effect of N, P, K and their different combinations on growth, yield and response to nematode infestation of two forage millet, *Pennisetum typhoides* varieties.

The combination of NPK at the rate of 90kg N+ 30kg P_2O_5 + 48kg K_2O/fed. gave the highest values of plant height, leaf area, number of tillers / plant and stem diameter, as well as fresh and dry forage yield of pearl millet. Whereas, 30kg N + 15kg P_2O_5 + 24 kg K_2O/fed. treatment gave the lowest values of the same characters in both seasons.

NPK application at 90 kg N + 30 Kg P_2O_5 + 48kg K_2O per fed. resulted in significantly reduction of the mixed nematode community of both soil and roots of pearl millet by 54.69% and 69.74% over treatment received 30 kg N + 15 kg P_2O_5 + 24 kg K_2O/fed. Concerning to the varietal effect on growth characters, fresh and dry forage yield of pearl millet, Shandawil I variety surpassed Composed variety in increasing the respective parameters values. Host reaction of the tested varieties to nematode infestation reveald that Composed variety was more susceptible to plant parasitic nematodes than Shandawil I variety.

Keywords: Pearl millet, N, P, K, fertilizer; Growth; Yield, Plant parasitic nematodes.

INTRODUCTION

In Egypt, it is well known that there is serious shortage in animal feed, especially during summer season. Thus, great efforts have been directed to improve summer fodder crops, pearl millet through optimizing agronomic paractices of which time of nitrogen, phosphorus and potassum applications are the most important factors. Abdalla and Darwish (1972) found that application of 120 kg N and 100 kg P_2O_2/fed to perennial millet gave the highest green yield. Ghobrial *et al.* (1984) found that use of 150 kg N + 150 kg P + 90 kg K/fed. gave the largest average green yield and the highest percentage of dry matter of hybrid millet. Chio *et al.* (1988) reported that pearl millet was better and higher in quality and fresh fodder yield than corn and Sorghum x Sudangrass hybrid. Forage yield of pearl millet and its components governed by nitrogen levels. There was a positive relationship between nitrogen level and pearl millet yield. Results of Mousa (1991) showed that fresh and DM forage yield of pearl millet increased with increasing N level up to 80 kg N/ha. Also, Manohar *et al.* (1992) revealed that pearl millet green fodder yield at all cuts taken increased with increasing N rate. Moreover, Patel *et al.* (1992) mentioned that green forage yield of

sorghum plants increased with rate of N application. Measurements of establishment performance of *Pennisetum purpureum* generally increased as N rate increased (Rusland *et al.*, 1993). Tag El-Din and Osman (1994) found that application of N & P fertilizers had highly significant effect on green and dry forage yields of guar. The same conclusion was obtained by (Abou-Deya and Nassar, 1994; and Singh and Tiwana, 1995). Furthermore, Jadhav et al. (1995) pointed out that application of 40 kg N/ha. significantly increased yield of pearl millet. El-Houssini and Nassar (1998) reported that vegetative growth and yield characters of pearl millet increased linearly due to each increment of nitrogen application up to 90 kg/fed.

Plant parasitic nematodes have been associated with yield losses in different field crops (Kraus - Schmidt and lewis, 1980). Damage from plant - parasitic nematodes is one of the principal yield limiting factors in the production of most legume crops (Sasser and Carter, 1982; and Trivedi and Barker, 1986).

The suitability of Sorghum (*Sorghum bicolor* (L.) Moench) as a host of *Meloidogyne* spp. has been addressed by several authors (Birchfield, 1983; and Thomas and Murray, 1987). *Meloidogyne arenaria* is one of principal yield - limiting pestes of peanut in the south eastren in U.S.A. (Ingram and Rodriguez - kabana, 1980; and Rodriguez - Kabana *et al.*, 1982). *Meloidogyne* spp., *Rotylenchulus reniform*, *Tylenchorhynchus* spp, and *xiphinema* spp. are considered limiting factors in crop production in Egypt (Tarjan, 1964; Oteifa and Tarjan, 1965; Ibrahim *et al.*, 1988 and 1994 and Ibrahim, 1990). Plant parasitic nematodes caused significant yield loss and economic damage to different field crops (Noe et al. 1991; Baird et al., 1996 and Ferris and Ferris, 1998).

The appropriate level and balance of essential plant nutrients is one of numerous management factors that could achieve optimum crop yield. It is also necessary to apply adequate fertilizer to improve high yield, so this investigation was conducted to estimate the effect of N, P, K, and their different combinations on growth, yield and response to nematode infestation of two forage pearl millet (*Pennisetum typhoides*) varieties.

MATERIALS AND METHODS

Two Field trails were performed at the Experimental Farm of Sers -Elliyan Agricultural Research Station, Menoufia Governorate, Agricultural Research Center in 1999 and 2000 summer seasons to study the effect of NPK fertilization on growth, yield and response to nematode infestation of two forage pearl millet (*Pennisetum typhoides*) varieties.

The experiment included 32 treatments arranged in split-plot design with four replicates. The treatments were the combinations of:

1 Two pearl millet varieties (allocated in the main plots), i.e. Composed variety and Shandawil I.

2 16 levels of N, P, and K fertilizer (laid out in the sub plots). The area of each plot was 10.5m^2 (1/400 fed). The seeds were planted in 20cm apart. The date of planting was in the 15 and 17 of May in the first and

second seasons, respectively. After 21 days from sowing, plants were thinned to secure two plants per hill. Soil samples were taken before sowing to determine the physical and chemical properties of the experimental soil according to Chapman and Pratt (1961) and shown in Table (1).

Nitrogen fertilizer (ammonium nitrate 33.5% N) at the rate of 30, 60, 90, and 120 kg N/fed., P fertilizer (Calcium superphosphate 15.5% P_2O_5) at the rate of 15 and 30 kg P_2O_5/fed. and K fertilizer (Potassium sulphate 48% K_2O) at the rate of 24 and 48 kg K_2O/fed. were applied. Phosphorus and potassium were added during seedbed preparation. Each N. fertilizer level was applied at three doses, the first dose after thinning, the second and third dose after the first and second cutting respectively. Other cultural practices of growing pearl millet plants were done as recommended.

Growth parameters were determined on five guarded plants at each sampling date 45, 80 and 115 days after sowing. The following data were recorded for each sample; plant height, leaf area, number of tillers / plant, and stem diameter. All plants of each plot were cut to determine fresh and dry forage yield in ton/fed. The separation of nematodes from soil was accomplished by a modification of Christie and Perry's method (1951). Direct seiving through 60 and 325 mech screens was employed. Resulting suspension was cleared by means of the Baermann-Pan's technique for separating active nematodes from soil particles (Goodey, 1957). Identification of nematode genera in repeated aliquots (1ml/each) followed the key's of Mai and Lyon (1960) as well as Goodey (1963). The hawksely counting slide under x 100 magnifications was used for determining each nematode genus/250 grams soil. Five-gram roots of each replicate were stained with hot acid fuchsine in lacto phenol for counting nematode population (Franklin, 1949).

Data obtained were statistically analysed according to the procedures outlined by Steel and Torrie (1980). Means were compared by least significant difference test (LSD) at 5% probability, which was developed by Fisher (1958).

Table (1) Chemical and Physical properties of the experimental soil for the upper foot layer (0-30cm) in 1999 and 2000 seasons.

Season	Partical size distribution %				$CaCo_3$	E.C. m mohs / cm /25°c	P.H In 1: 2.5	Texture
	Coarse sand	Fine sand	Silt	Clay				
1999	1.9	51.9	28.7	17.5	1.8	0.37	7.5	Sandy loam
2000	1.4	50.7	32.6	15.3	1.7	1.38	7.3	Sandy loam

NPK available nutrients			
Season	Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)
1999	39.0	7.18	269.40
2000	33.0	6.83	291.63

Soluble salts in soil paste extract								
Season	Cations (me q/L)				Anions (me q/L)			
	Na^+	K^+	Ca^{++}	Mg^{++}	$CO3^-$	$Hco3^-$	Cl^-	$SO4^{--}$
1999	1.52	0.08	4.65	3.44	-	1.0	2.0	2.7
2000	0.42	0.20	7.04	5.24	-	1.3	6.2	6.3

RESULTS AND DISCUSSION

I- Effect of NPK fertilizer on:

a) Growth Characters and forage yield:

There were significant response to NPK with all growth parameters as well as green and dry forage yield / fed. of pearl millet taken except for leaf area and stem diameter in the 1st cut of the 2nd season as shown in Tables (2 and 3).

Fertilizer treatment of NPK at 90 kg N + 30 kg P_2O_5 + 48 kg K_2O / fed. gave the highest value of plant height (126.54 and 105.47), while the lowest one was obtained from 30 kg N + 15 kg P_2O_5 + 24 kg K_2O / fed. (96.34 and 73.61) in both seasons. Also, the data presented in the same table indicate that 90 kg N + 30 kg P_2O_5 + 48 kg K_2O / fed. gave the greatest values of leaf area (153.44 and 191.58cm^2), number of tillers / plant (2.67 and 4.43) and stem diameter (1.20 and 1.39cm), whereas 30 kg N + 15 kg P_2O_5 + 24 kg K_2O / fed. treatment had the lowest value of leaf area (103.66 and 134.94cm^2), number of tillers / plant (1.54 and 2.72) and stem diameter (0.73 and 1.01cm) over three cuts in both seasons, respectively. On the other hand, in both seasons it could be noticed that the second cut was superior of plant height (132.31 and 109.66 cm), leaf area (186.03 and 250.89 cm^2) number of tillers / plant (2.79 and 5.29) and stem diameter (1.19 and 1.58 cm) than the other cuts tables (2 and 3). While the 3rd cut in the first season and 1st cut in second season was inferior in plant height (94.58 and 56.75 cm), leaf area (68.60 and 103.83 cm^2), number of tillers / plant (1.24 and 1.66), and stem diameter (0.55 and 0.81 cm) at the first cut in both seasons. These results might be attributed to the greatest effects of NPK which promoted plant height, leaf area, number of tiller/plant and stem diameter of pearl millet. Data presented in Tables (2 and 3) show significant differences among NPK fertilization in fresh and dry weight forage yield ton / fed.

Regarding the mean of fresh and dry forage yield, the results indicate that fertilizer treatment of NPK at 90 kg N + 30 kg P_2O_5 + 48 kg K_2O / fed. gave the highest values of fresh forage yield (9.80 and 7.49 ton/fed.) and dry yield (3.76 and 1.55 ton/fed.), while 30 kg N + 15 kg P_2O_5 + 24 kg K_2O / fed. possessed the lowest values for fresh (3.75 and 3.86) and dry (1.19 and 0.61) yields, in both seasons, respectively. In both seasons, higher fresh forage and dry yield as mean for the NPK fertilization was recorded at 2nd cut more than the other cuts. The response of pearl millet growth parameters and forage yield to the other NPK fertilizer treatments revealed intermediate status. The increase of plant growth by increasing N rates is most certainly due to the role of N in improving vegetative growth. In this connection, the effect of N fertilizer on accumulating dry matter could also attributed to increasing photosynthesis (Thomposon and Troeh, 1980). Such results were recorded by Manohar et al. (1992) on pearl millet and Rusland et al. (1993) on elephant grass. El-Houssini & Nassar (1998) found that most vegetative growth and yield characters of pearl millet increased lineary due to each increment of nitrogen application up to 90 kg/fed.

Table (2): Effect of nitrogen, phosphorus, and potassium on growth characters, fresh forage yield and dry forage yield of pearl millet in 1999 growing seasons.

Rate of fertilizer application in kg/fed.			Plant height (cm)				Leaf area (cm^2)				Number of tillers / plant			
N	P_2O_5	K_2O	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean
30	15	24	97.38	97.07	94.58	96.34	68.60	127.59	114.80	103.66	1.24	1.75	1.64	1.54
30	15	48	97.80	97.18	95.16	96.71	72.78	131.53	124.78	109.70	1.28	1.75	1.68	1.57
30	30	24	99.42	98.17	100.50	99.36	74.57	133.60	125.11	111.09	1.38	1.75	1.78	1.64
30	30	48	103.23	100.62	101.18	101.68	77.56	137.16	128.99	114.57	1.39	1.82	1.79	1.67
60	15	24	103.31	103.27	102.81	103.13	77.19	142.98	132.42	117.53	1.40	1.86	1.80	1.69
60	15	48	105.77	106.71	103.31	105.26	79.33	145.21	132.73	119.09	1.44	1.91	1.84	1.73
60	30	24	106.30	107.58	103.44	105.77	82.51	145.79	132.75	120.35	1.48	1.94	1.88	1.77
60	30	48	113.09	118.20	112.13	114.47	92.97	158.45	143.93	131.78	1.80	2.20	2.21	2.07
90	15	24	114.40	119.40	113.93	115.91	95.30	160.92	144.67	133.63	2.01	2.31	2.41	2.24
90	15	48	117.75	121.20	114.63	117.86	103.59	167.87	150.70	140.72	2.22	2.52	2.62	2.45
90	30	24	119.47	126.89	118.02	121.46	110.20	178.59	153.12	147.30	2.39	2.68	2.79	2.62
90	30	48	124.44	132.31	122.88	126.54	114.79	186.03	159.50	153.44	2.41	2.79	2.81	2.67
120	15	24	112.29	116.35	110.94	113.19	89.25	154.48	142.95	128.89	1.72	2.11	2.12	1.98
120	15	48	110.18	113.52	110.04	111.25	85.95	154.44	138.28	126.22	1.60	2.10	2.00	1.90
120	30	24	109.82	109.85	109.37	109.68	83.90	152.11	137.23	124.41	1.58	2.03	1.98	1.86
120	30	48	94.97	109.37	107.79	104.04	82.64	152.03	135.99	123.55	1.50	1.99	1.90	1.79
Mean			108.10	111.11	107.54	108.92	86.94	151.80	137.37	125.37	1.68	2.09	2.08	1.95
L.S.D. 5%			7.83	12.90	17.82	11.99	15.50	30.11	24.59	26.52	0.41	0.47	0.41	0.46

Table (2): Cont.

Rate of fertilizer application in kg/fed.			Stem diameter (cm)				Fresh forage yield ton/fed.				Dry forage yield ton/fed.			
N	P_2O_5	K_2O	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean
30	15	24	0.55	0.92	0.73	0.73	2.70	5.38	3.17	3.75	0.92	1.43	1.22	1.19
30	15	48	0.57	0.96	0.73	0.75	4.30	7.05	5.91	5.75	1.41	3.12	1.63	2.05
30	30	24	0.60	0.96	0.75	0.77	4.49	7.50	6.16	6.05	1.50	3.32	1.74	2.19
30	30	48	0.62	0.99	0.77	0.79	4.77	7.81	6.48	6.35	1.53	3.43	1.81	2.26
60	15	24	0.62	0.99	0.80	0.80	4.81	8.23	6.88	6.64	1.56	3.45	1.94	2.32
60	15	48	0.62	1.02	0.80	0.81	4.93	8.29	7.06	6.76	1.66	3.73	2.00	2.46
60	30	24	0.66	1.02	0.83	0.84	4.97	8.86	7.71	7.18	1.69	3.86	2.09	2.55
60	30	48	0.76	1.03	0.93	0.92	5.70	9.91	9.80	8.47	1.98	4.64	2.39	3.01
90	15	24	0.99	1.11	1.02	1.04	5.89	9.99	9.81	8.56	2.04	5.01	2.41	3.15
90	15	48	1.12	1.14	1.10	1.12	5.94	10.53	10.61	9.03	2.16	5.45	2.59	3.40
90	30	24	1.15	1.16	1.16	1.16	6.27	11.21	10.81	9.43	2.30	5.79	2.76	3.62
90	30	48	1.20	1.19	1.21	1.20	6.53	11.68	11.19	9.80	2.39	6.03	2.87	3.76
120	15	24	0.72	1.07	0.89	0.89	5.42	9.69	8.91	8.01	1.95	4.46	2.32	2.91
120	15	48	0.69	1.07	0.88	0.88	5.36	9.59	8.34	7.76	1.84	4.19	2.31	2.78
120	30	24	0.68	1.06	0.85	0.86	5.32	9.52	8.25	7.69	1.84	4.13	2.22	2.73
120	30	48	0.67	1.04	0.84	0.85	5.11	9.01	7.79	7.30	1.76	3.97	2.18	2.64
Mean			0.67	1.05	0.89	0.87	5.16	9.02	8.06	7.41	1.78	4.13	2.16	2.69
L.S.D. 5%			0.27	0.15	0.21	0.24	1.06	1.39	1.85	1.36	0.60	0.96	0.33	0.53

Table (3): Effect of nitrogen, phosphorus, and potassium on growth characters, fresh forage yield and dry forage yield of pearl millet in 2000 growing seasons.

Rate of fertilizer application in kg/fed.			Plant height (cm)				Leaf area (cm^2)				Number Of tillers / plant			
N	P_2O_5	K_2O	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean
30	15	24	56.75	86.74	77.33	73.61	103.83	172.79	129.19	134.94	1.66	3.86	2.64	2.72
30	15	48	58.54	89.86	80.43	76.28	109.46	179.77	136.58	141.94	1.73	4.03	3.38	3.05
30	30	24	60.81	92.83	80.75	78.13	111.21	183.81	139.15	144.72	1.81	4.05	3.44	3.10
30	30	48	62.28	94.02	82.12	79.47	112.86	184.48	140.12	145.82	1.82	4.05	3.59	3.15
60	15	24	65.10	94.30	83.33	80.91	115.14	187.81	142.88	148.61	1.92	4.20	3.70	3.27
60	15	48	65.13	95.59	83.92	81.55	118.31	195.80	143.35	152.49	1.92	4.28	3.76	3.32
60	30	24	70.38	96.13	87.36	84.62	120.06	195.81	147.38	154.42	1.93	4.31	3.89	3.38
60	30	48	91.92	104.28	93.00	96.40	125.06	208.29	160.90	164.75	2.28	4.68	4.50	3.82
90	15	24	95.75	104.50	93.00	97.75	129.84	216.99	164.83	170.55	2.33	4.77	4.69	3.93
90	15	48	95.99	106.18	96.36	99.51	132.95	226.40	167.61	175.65	2.48	4.88	4.74	4.03
90	30	24	102.12	108.63	96.88	102.54	141.43	240.90	172.22	184.85	2.64	5.07	5.05	4.25
90	30	48	106.38	109.66	100.38	105.47	146.33	250.89	177.52	191.58	2.75	5.29	5.26	4.43
120	15	24	88.31	102.19	91.00	93.83	124.48	208.13	160.19	164.27	2.23	4.49	4.37	3.69
120	15	48	86.40	100.82	90.58	92.60	123.24	204.43	159.19	162.49	2.10	4.44	4.23	3.59
120	30	24	79.49	100.32	89.28	89.70	122.74	196.25	154.19	157.73	2.00	4.40	4.05	3.48
120	30	48	73.25	98.02	87.42	86.23	122.01	196.05	151.25	156.44	1.95	4.39	3.89	3.41
Mean			78.66	99.00	88.32	88.66	122.50	203.04	152.88	159.45	2.10	4.45	4.07	3.54
L.S.D. 5%			14.34	7.60	8.17	10.93	N.S	40.03	30.12	32.17	0.62	0.65	0.68	0.67

Table (3): Cont.

Rate of fertilizer application in kg/fed.			Stem diameter (cm)				Fresh forage yield ton/fed.				Dry forage yield ton/fed.			
N	P_2O_5	K_2O	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean
30	15	24	0.81	1.16	1.05	1.01	4.31	3.65	3.62	3.86	0.73	0.58	0.53	0.61
30	15	48	0.82	1.23	1.05	1.03	4.51	4.66	4.78	4.65	0.77	0.79	0.71	0.76
30	30	24	0.84	1.26	1.09	1.06	4.64	4.85	5.07	4.85	0.79	0.80	0.75	0.78
30	30	48	0.85	1.27	1.12	1.08	4.70	4.96	5.10	4.92	0.80	0.83	0.75	0.79
60	15	24	0.88	1.30	1.12	1.10	4.90	5.17	5.15	4.07	0.86	0.87	0.78	0.84
60	15	48	0.89	1.31	1.14	1.11	4.94	5.27	5.28	5.16	0.91	0.87	0.81	0.86
60	30	24	0.91	1.31	1.16	1.13	5.11	5.61	5.32	5.35	0.93	0.93	0.86	0.91
60	30	48	0.98	1.42	1.30	1.23	5.44	7.63	6.37	6.48	1.06	1.16	1.27	1.17
90	15	24	1.01	1.45	1.32	1.26	5.62	7.86	6.57	6.68	1.09	1.44	1.30	1.27
90	15	48	1.02	1.51	1.33	1.29	5.66	8.30	6.78	6.91	1.15	1.56	1.42	1.38
90	30	24	1.08	1.52	1.41	1.34	6.03	8.83	6.84	7.23	1.24	1.66	1.51	1.47
90	30	48	1.13	1.58	1.47	1.39	6.22	9.19	7.06	7.49	1.34	1.73	1.57	1.55
120	15	24	0.97	1.40	1.27	1.21	5.43	7.55	6.09	6.36	1.05	1.21	1.22	1.16
120	15	48	0.94	1.37	1.23	1.18	5.22	7.09	5.86	6.06	0.98	1.09	1.15	1.07
120	30	24	0.93	1.37	1.23	1.18	5.21	6.53	5.76	5.83	0.98	1.01	1.05	1.01
120	30	48	0.92	1.34	1.21	1.16	5.14	5.73	5.60	5.49	0.93	0.97	0.90	0.93
Mean			0.94	1.36	1.22	1.17	5.19	6.43	5.70	5.71	0.97	1.10	1.04	1.04
L.S.D. 5%			N.S	0.12	0.18	0.14	0.67	0.90	0.82	0.73	0.18	0.22	0.15	0.16

Phosphorus application significantly increased the growth parameters. This result may be ascribed to the fact that P may encourage the metabolic processes (Nasr-alla *et al.*, 1998). Also P stimulates the nitrogenase activity as well as meristimic activity (Tisdale and Nelson, 1975). Similar resuits were obtained by Ali *et al.* (1997) on Meskawy barley mixtures. They found that plant height, green and dry weight / plant at different cuts as well as green and dry forage yield were significantly increased by P up to 40 kg P_2O_5 /fed. Nassar (1999) found that raising phosphorus level up to 30 kg P_2O_5 /fed. positively affected all growth traits, fresh and dry forage yields in both seasons.

Potassium application increased pearl millet growth, forage yield as well as dry forage yield. This increase may be due to the fact that K is essential element to growth and play an active and important role in the function of enzymes required for biological processes and absorption of different nutrients (Tisdal and Nelson 1975 and Ghatak *et al.*, 1997), our results are in agreement with those of Mosaad and Abdel Salam (1992) on soybean and Badr et al. (1998) on Cowpea. Ghobrial *et al.* (1984) reported that the use of 150 kg N + 150 kg P + 90 kg K/fed. gave the largest average green yield and the highest % of dry matter of hybrid millet. Badr et al. (1998) found that applying 45 kg N/fed, 30 kg P_2O_5 /fed. and 45 kg K_2O / fed. gave the highest values of growth characters, green and dry forage yield of Cowpea (*Vigna sinensis*) and there were significant interactions between NPK factors on some studied traits. It can be concluded that the combination of N, P, and K has a synergistic effect for each other in improving the productivity of pearl millet.

b) Nematode population:

The results illustrated in tables (4 and 5) show that increasing NPK levels reduced significantly nematode community in soil and pearl millet roots at all cuts in two seasons. The grand mean results indicate that NPK application at 90 kg N + 30 kg P_2O_5 + 48 kg K_2O / fed. resulted in reducing the mixed nematode community of both soil and roots by 54.69 % and 69.74 %, respectively, over treatment received 30 kg N + 15 kg P_2O_5 + 24 kg K_2O / fed. as shown in tables (4 and 5). These results confirmed those obtained by Rizk (1992) who reported that inorganic fertilization (NPK) decreased the plant parasitic nematodes population in both soil and roots. He added that double inorganic fertilization was the most effective in reducing nematode population in soil. The present data are in agreement with the findings of Hinz and Decker (1975) and Maareg (1984), who, found that the addition of organic fertilizer resulted in suppressing the plant parasitic nematodes. Mankau and Mankau (1975) found that the addition of mineral nitrogenous fertilizer reduced intensity of nematode. Salem *et al.* (1983) found that citrus nematode population in soil was decreased with superphosphat. Midan *et al.* (1985) reported that excess potassium fertilizers diminished the severity of tomato root infection with nematode to the lowest limit. These results are similar to those found by Barakat and Marei (2001) who found that increasing N. fertilization, remarkable decreased nematode population associated with root sorghum system and soil.

Table (4): Average numbers of the mixed nematode community per 250g. soil of pearl millet treated with NPK fertilizer at 1999 and 2000 seasons.

Rate of fertilizer application in kg/fed.			Average No. of the mixed nematode community / 250g./soil								Grand mean
			1999 season				2000 season				
N	P_2O_5	K_2O	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	
30	15	24	674.76	451.80	577.28	567.95	946.76	583.33	593.67	707.92	637.94
30	15	48	702.88	455.04	583.39	580.44	1025.42	634.05	606.49	755.32	667.88
30	30	24	725.04	484.08	620.63	609.92	1090.87	674.53	645.20	803.53	706.73
30	30	48	733.54	567.17	646.49	649.07	1136.32	702.63	672.09	837.01	743.04
60	15	24	583.53	374.94	479.24	479.24	705.58	462.22	492.87	553.56	516.40
60	15	48	601.93	407.54	520.91	510.13	766.94	502.41	535.73	601.69	555.91
60	30	24	634.37	418.63	536.72	529.91	815.89	534.48	557.97	636.11	583.01
60	30	48	654.93	433.56	554.16	547.55	849.89	556.75	569.92	658.85	603.20
90	15	24	501.55	176.14	365.85	347.85	484.25	261.69	226.25	324.06	335.96
90	15	48	500.29	168.87	326.22	331.79	474.06	249.66	217.20	313.64	322.72
90	30	24	461.43	158.74	330.14	316.77	445.62	245.98	204.17	298.59	307.68
90	30	48	460.27	146.04	303.73	303.35	409.97	226.31	187.84	274.72	289.04
120	15	24	532.22	241.59	382.05	385.29	486.66	271.37	376.58	378.20	381.75
120	15	48	533.57	262.60	415.29	403.82	493.88	272.59	409.33	391.93	397.88
120	30	24	554.40	279.36	441.80	425.19	526.36	288.69	435.46	416.84	421.02
120	30	48	555.80	291.24	460.20	435.75	559.96	300.71	453.60	438.09	436.92
Mean			588.12	332.33	471.51	463.99	701.15	422.96	449.02	524.38	494.19
L.S.D. 5%			97.62	98.59	95.98	110.16	332.94	118.30	186.67	178.20	

Table (5): Average numbers of the mixed nematode community per 5g. roots of pearl millet treated with NPK fertilizer at 1999 and 2000 seasons.

Rate of fertilizer application in kg/fed.			Average No. of the mixed nematode community / 5g.roots								Grand mean
			1999 season				2000 season				
N	P_2O_5	K_2O	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	
30	15	24	67.14	39.85	49.69	52.23	59.46	27.81	26.25	37.84	45.04
30	15	48	72.98	43.32	58.09	58.13	64.63	30.23	27.86	40.91	49.52
30	30	24	77.64	46.08	58.30	60.67	68.76	32.16	29.64	43.52	52.10
30	30	48	81.33	48.20	61.80	63.78	71.63	33.85	30.88	45.45	54.62
60	15	24	48.46	28.08	37.46	38.00	43.79	16.50	21.79	27.36	32.68
60	15	48	52.68	28.76	40.72	40.72	47.59	17.93	23.69	29.74	35.23
60	30	24	56.04	30.60	43.33	43.32	50.64	19.08	25.20	31.64	37.48
60	30	48	58.83	32.09	45.13	45.35	52.75	20.13	25.42	32.77	39.06
90	15	24	18.69	19.17	18.25	18.70	17.25	9.95	15.91	14.37	16.54
90	15	48	17.66	18.24	17.58	17.83	16.56	9.36	15.05	13.66	15.75
90	30	24	16.58	17.15	16.52	16.75	15.56	8.80	14.63	12.99	14.87
90	30	48	15.25	15.77	15.22	15.41	14.32	8.09	13.13	11.85	13.63
120	15	24	19.76	22.83	25.22	22.60	20.13	12.66	16.35	16.38	19.49
120	15	48	21.48	24.82	27.41	24.57	21.88	13.76	16.92	17.52	21.05
120	30	24	22.85	26.40	29.16	26.14	23.27	14.64	17.40	18.44	22.29
120	30	48	32.86	26.46	30.38	29.9	24.25	15.50	18.13	19.29	24.60
Mean			42.51	29.24	35.89	35.88	38.28	18.15	21.14	25.86	30.87
L.S.D. 5%			26.15	11.67	14.95	17.33	16.76	7.57	7.98	12.47	

II- Varietal effect:

a) Growth characters and forage yield:

The results illustrated in Table (6) show the varietal effects on plant height, leaf area, number of tillers / plant, and stem diameter of pearl millet. The tested varieties differed significantly with regard to these four respective parameters Shandawil I variety recorded higher value of plant height (114.96 and 95.63 cm) than that of Composed variety (102.87 and 81.60 cm). Plant height of both varieties was not significant at 3rd cut in both seasons. Also, Shandawil I variety produced higher value of leaf area (135.38 and 157.26 cm^2), than that of composed variety (115.26 and 143.68 cm^2). Leaf area of both varieties was not significant at 3rd cut of the first season and the first cut of the second season.

From the same table, it can be noticed also that the plants of Shandawil I variety produced the greatest number of tillers / plant, (2.03 and 3.78), while the variety Composed could be ranked in the second order for this character (1.06 and 3.30). Number of tillers / plant of both varieties was not significant at 1st and 3rd cuts in the first season and the first cut in the second season. The greatest stem diameter was recorded for Shandawil I plants (0.95 and 1.28 cm) where as the least stem diameter was recorded for Composed variety (0.85 and 1.07 cm). Stem diameter of both varieties was not significant at the first cut of the first season. On the other hand, it could be noticed from Table (6) that the second cut was higher in average for the tested varieties in plant height, leaf area, number of tillers per plant, and stem diameter than the other cuts. This may be due to the growth activity during the second cutting period.

The two varieties evaluated in this work showed significant differences in either fresh and dry forage yields (ton/fed.) as shown in Table (6), except for fresh forage yield in the 2nd and 3rd cut of the first season and 3rd cut in the second season, and the dry yield of 1st and 3rd cut in the first season and 2nd and 3rd cut in the second season. Regarding the fresh forage yield, the results indicate that Shandawil I variety gave the highest value (8.05 and 6.21 ton/fed.). While Composed variety possessed the lowest values (6.77 and 5.35 ton/fed.). On the other hand, the dry yield Shandawil I variety produced greater values (2.92 and 1.12 ton/fed.), than composed variety which had the leaser values (2.45 and 0.95 ton/fed.) in both seasons, respectively.

Generally, Shandawil I variety was superior in fresh and dry forage yields. Also, the second cut gave higher fresh and dry forage yield as a mean for the tested varieties than the other cuts. Differences between the two studied cultivars could be mainly attributed to the variation in their growth patterns, their response to the environmental conditions and their genetic variability.

Table (6): Effect of varietal variation on growth characters, fresh forage yield and dry forage yield of pearl millet in 1999 and 2000 growing seasons.

Varieties	Plant height (cm)				Leaf area (cm^2)				Number of tillers / plant			
	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean
					1999 season							
Composite	101.99	101.24	105.39	102.87	80.75	131.00	134.34	115.26	1.61	1.98	2.01	1.06
Shandawil I	114.21	120.97	109.70	114.96	93.14	172.60	140.40	135.38	1.75	2.21	2.15	2.03
Mean	108.10	111.11	107.54	108.92	86.94	151.80	137.37	125.37	1.68	2.09	2.08	1.95
L.S.D. 5 %	1.66	16.41	N.S	5.85	10.46	32.09	N.S	16.45	N.S	0.18	N.S	0.76
					2000 season							
Composite	66.86	91.00	87.60	81.60	114.50	177.21	139.34	143.68	1.92	4.28	3.71	3.30
Shandawil I	90.47	107.01	89.58	95.63	130.49	228.87	166.42	175.26	2.72	4.61	4.44	3.78
Mean	78.66	99.00	88.32	88.66	122.50	203.04	152.88	159.47	2.10	4.45	4.07	3.54
L.S.D. 5 %	4.52	11.94	N.S	6.67	N.S	38.00	15.22	20.49	N.S	0.33	0.96	0.45
Varieties	**Stem diameter**				**Fresh forage yield ton /fed.**				**Dry forage yield ton/fed.**			
	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean
					1999 season							
Composite	0.73	1.00	0.82	0.85	4.52	8.56	7.23	6.77	1.66	3.74	1.97	2.45
Shandawil I	0.80	1.09	0.97	0.95	5.79	9.47	8.88	8.05	1.90	4.51	2.34	2.92
Mean	0.76	1.05	0.89	0.90	5.16	9.02	8.06	7.41	1.78	4.13	2.16	2.69
L.S.D. 5 %	N.S	0.09	0.10	0.09	0.19	N.S	N.S	0.19	N.S	0.29	N.S	0.18
					2000 season							
Composite	0.74	0.94	1.16	1.07	4.45	6.05	5.54	5.35	0.79	1.08	0.99	0.95
Shandawil I	1.13	1.30	1.27	1.28	5.94	6.81	5.87	6.21	1.16	1.11	1.08	1.12
Mean	0.94	1.42	1.22	1.17	5.19	6.43	5.70	5.71	0.97	1.10	1.04	1.04
L.S.D. 5 %	0.15	0.06	0.08	0.12	0.88	0.68	N.S	0.64	0.09	N.S	N.S	0.04

Table (7): Occurrence and density of nematode community per 250g. soil and per 5g. roots of pearl millet.

A- Nematode community in soil		
Nematode genera	Population density / 250g. soil	% occurrence
Criconema	27.0	16.0
Helicotylenchus	15.0	8.0
Heterodera	13.0	10.0
Longidorus	10.0	7.0
Meloidogyne	17.0	9.0
Pratylenchus	40.0	25.0
Rotylenchulus	10.0	14.0
Trichodorus	26.0	11.0
Tylenchorhynchus	23.0	10.0
B-Nematode community associated with roots		
Nematode genera	Population density / 5g. roots	% occurrence
Meloidogyne	39.0	25
Pratylenchus	80.0	75

b) Response of the tested varieties to plant parasitic nematodes:

Plant parasitic nematode genera which were found in the soil and associated with the roots of pearl millet plants are presented in Table (7 A and B). Data indicate that the nematode genera were found as follows: *Circonema, Helicotylenchus, Heterodera, Longidorus, Pratylenchus, Rotylenchulus, Trichodorus, Tylenchorhynchus* and *Meloidogyne*. These results confirm the reports of Pinto and Lordello (1980) and Barakat and Marei (2001) who found the same genera in the soil and roots of pearl millet and forage sorghum.

Results in Table (8) demonstrate clearly that there is significant difference between nematode population density in the soil and roots of the tested per millet cultivars in the two seasons, except for nematode community in the roots at 2nd cut in the 1st season and 3rd cut in the 2nd season. The lowest nematode community was found in the soil of pearl millet cv. Shandawil I (326.94 and 422.27 / 250g soils). On the contrary, the highest nematode community was in the soil of pearl millet cv. Composed (598.83 and 626.51 / 250g soils), in the 1st and 2nd season, respectively.

On the other hand the average number of nematode community in the roots of Shandawil I variety gave the leaser value (28.96 and 20.51 /5g roots), while Composed variety had the greater value (42.81 and 31.22 /5g. roots) at the two successive seasons, respectively.

Also, it can be noticed that Composed variety is more susceptible to nematodes than Shandawil I variety. So it explains that why productivity of Composed variety is lesser than of Shandawil I variety. Motalaota et al. (1987) reported that sorghum cultivar Pioneer 8222 was a good host for *Pratylenchus zeae* but it was a nonhost for *P. crenalus*. Windham and Williams (1987) found that corn hybrids are relatively poor hosts for *Meloidogyne* spp. Trevathan *et al.* (1985) found that the plant parasitic nematodes most commonly associated with sorghum were: *Pratylenchus zeae, Tylenchorhynchs martini* and *Helicotylenchus dihystera*. *Pratylenchus zeae* occurred in 100% of the samples.

Table (8): Average number of the mixed nematode community per 250g. soil and 5g. roots of pearl millet varieties at 1999 and 2000 seasons.

Varieties	Average No. of the mixed nematode community / 250g. soil.								Ground Mean
	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	
	1999				2000				
Composite	797.70	395.05	608.19	598.83	797.15	525.32	556.99	626.51	612.67
Shandawil I	378.53	269.62	334.82	326.94	605.16	320.60	341.06	422.27	374.61
Mean	588.12	332.33	471.51	463.99	701.15	422.96	449.02	524.38	494.19
L.S.D. 5%	185.80	79.46	23.78	148.88	44.49	188.63	65.00	124.84	
	5g. roots								
	1999				2000				
Composite	51.45	34.20	42.76	42.81	49.62	20.96	23.05	31.22	76.03
Shandawil I	33.58	24.27	29.02	28.96	26.94	15.35	19.23	20.51	24.74
Mean	42.51	29.24	35.89	35.88	38.28	18.15	21.14	25.86	30.87
L.S.D. 5%	8.33	N.S	12.92	9.74	12.68	3.60	N.S	6.36	

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تأثير التسميد الآزوتي والفوسفاتي والبوتاسي على نمو محصول بعض أصناف الدخن ومدى استجابتها للإصابة بالنيماتودا.

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قسم بحوث محاصيل العلف -معهد المحاصيل الحقلية – مركز البحوث الزراعية

أجريت تجربتان حقليتان بمحطة التجارب الزراعية بسرس الليان محافظة المنوفية خلال موسمي الزراعة ١٩٩٩ ، ٢٠٠٠ لدراسة تأثير مخاليط التسميد الآزوتي والفوسفاتي والبوتاسي على بعض صفات النمو الخضرية والمحصول العلفي لبعض أصناف الدخن ومدى استجابتها للإصابة بالنيماتودا .

وأظهرت النتائج -:

٢ سجل مخلوط التسميد الآزوتي والفوسفاتي والبوتاسي بمعدل 90)كجم ن 30 +كجم فو٢ أ٥ + ٤٨ كجم بو٢ أ /فدان (أعلى القيم لصفات النمو المدروسة ومحصول العلف الأخضر والجاف للفدان ، بينما أعطى معدل التسميد 30)كجم ن 15 +كجم فو٢ أ٥ + ٢٤ كجم بو٢ أ /فدان (أقل قيمة لهذه الصفات .

٣ أدى إضافة مخلوط التسميد بمعدل 90كجم ن 30 +كجم فو٢ أ٥ + ٤٨ كجم بو٢ أ /فدان إلى انخفاض معنوي في مجتمع أعداد النيماتودا في كل من تربة وجذور الدخن بنسبة 54.69%، 69.74% على التوالي بالمقارنة بمعاملة التسميد بمعدل 30كجم ن 15 +كجم فو٢أ٥ + ٢٤ كجم بو٢ أ /فدان .

٤ تفوق صنف شندويل 1عن الصنف التركيبي للدخن في صفات النمو المدروسة ومحصول العلف الأخضر والجاف للفدان .

٥ أظهرت النتائج أن الصنف التركيبي للدخن أكثر حساسية للإصابة بالنيماتودا عن الصنف شندويل . 1