American-Eurasian J. Agric. & Environ. Sci., 17 (6): 450-457, 2017
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2017.450.457

Impact of Mineral, Organic and Biofertilization on Growth, Yield and Quality of Fodder Pearl Millet

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Abstract: Two field experiments were conducted at Kafr Al-Hamam Agricultural Research Station, Agric. Research Center (ARC) during two successive summer seasons of 2014 and 2015. This investigation aimed to determine the effect of the following treatment combinations of mineral, organic and bio-fertilization on growth, yield and quality of pearl millet (var.Shandweel-1): T_1 mineral fertilizer (recommended N 120 kg fad^{-1}) as control, T_2 bio-fertilizer (Nitrobine), T_3 organic fertilizer (3 ton compost fad^{-1}), T_4 (60 kg N fad^{-1} + Nitrobine), T_5 (60 kg N fad^{-1} + 3 ton compost fad^{-1}), T_6 (60 kg N fad^{-1} + 6 ton compost fad^{-1}) and T_7 (Nitrobine + 3 ton compost fad^{-1}). The randomized complete block design was used with three replications. The important results can be summarized as follows: Application of (60 kg N fad^{-1} +6 ton compost fad^{-1}) resulted in superior plants in plant height (183.77, 166.53 and 136.87 cm), number of leaves plant $^{-1}$(8.87, 7.33 and 7.37), number of tillers plant $^{-1}$ (9.67, 8.60 and 7.00), stem diameter (1.53, 1.17 and 1.03 cm) and leaf area plant $^{-1}$ (1954.40, 1245.29 and 1056.38 cm^2) for three cuts in combined analysis, respectively. Also, this treatment was effective in producing higher total fresh and dry forage yields, average dry forage yield increases for treatment (60 kg N fad^{-1} + 6 ton compost fad^{-1}) relative to treatment (120 kg N fad^{-1}) as control were 54.44 % in the 1st cut, 44.98 % in the 2nd cut, 53.49 % in the 3rd cut and 50.74 % in the total dry forage yield, respectively. Leaf/ stem ratio, crude protein yield (kg fad^{-1}), crude fiber, nitrogen free extract, ash, total digestible nutrients and digestible crude protein yields (kg fad^{-1}) as well as digestible energy (K Cal/ gm of dry matter) were significantly increased by treatment of (60 kg N fad^{-1} + 6 ton compost fad^{-1}) compared with other treatments. Concerning the economic revenue, the highest net farm return was achieved from the treatment (60 kg N fad^{-1} + 6 ton compost fad^{-1}) (10819 L.E. fad^{-1}); it also recorded the highest net return per one invested L.E. (2.62 L.E.). According to results of present study, it can be included that farmers can obtain the same pearl millet yield if they using 60 kg fad^{-1} of nitrogen with 6 ton compost fad^{-1}. In this way, decreasing nitrogen fertilizer help to reduce environment pollution and produced a better forage quantity and quality with the lowest cost of yield.

Key words: Pearl millet · Organic fertilization · Mineral fertilization · Bio-fertilizer · Forage yield · Protein yield · Fiber yield

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.) is an annual grass, native from Africa. It shows tolerance and drought resistance characteristics, with excellent efficiency in water use for forage production. It can grow in sandy and low fertility soils, with an annual rainfall mean of 200 mm [1]. In Egypt, pearl millet has been grown mainly as a forage crop in summer season. Many dairy farmers consider it superior to other fodder crops for milk production and farmers producing beef are using to good advantage because the mean hydrocyanic acid potential (HCN-P) values for the crop are very low as compared with sorghum and sorghum-sudan grass hybrids [2]. Nitrogen plays an important role in increasing forage production with better nutritive value. The cost of nitrogen fertilizers is very expensive; it becomes imperative to substitute nitrogen by some other cheaper sources, which may partially meet the nitrogen required by the crop. A useful method to reduce the input of

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chemical fertilizers in agriculture and to control soil and water pollution may be represented by the use of bio-fertilizers (microbial inoculants) and organic manure could be recommended [3]. Bio-fertilizers and organic manure are cheap and eco-friendly source of plant nutrients for sustainable crop production in low-input agriculture [4]. Zerbini and Thomas [5] indicated that use of bio-fertilizers instead of chemical fertilizers is not sufficient whereas using of bio-fertilizers increased the efficiency of chemical fertilizers, however, by low using of chemical fertilizers , maximum crop yield achieved. Application of organic manures similarly, has positive effects on soil physical and biochemical properties. Abd El-Aziz [6] found that application of 120 kg N+ 40 m^3 farmyard manure fad^{-1} caused a significant increase in the fresh and dry forage yields of pearl millet in sandy soil. Abdullahi *et al*. [7] showed that bio-fertilizer + poultry manure recorded highest plant performance; plant height, number tillers $plant^{-1}$ followed by bio-fertilizer alone and poultry manure. Mahfouz *et al*. [8] stated that FYM and N fertilizer that achieve maximum productivity and improvement the most of the forage quality from the same area in less time as possible with the lowest cost of yield whereas, increasing FYM level from 45 to 90 m^3 ha^{-1} led to significant increase in forage DM (%) and CP (%) with significant decreased in CF (%). Hoda *et al*. [9] proposed that combination between bio-fertilizer with 75% N of its recommended nitrogen rate 100% (120 kg N fad^{-1}) increased growth, forage yield and quality traits of pearl millet and save about 25% of nitrogen fertilizer with decreasing hazard environmental effects that may be caused by mineral N-fertilizer. Golada *et al.* [10] observed that application of FYM 10 ton ha^{-1} significantly increased yields in both the cuts also, inoculation of pearl millet seed with bio-fertilizer significantly increased the yield over without inoculation. Mekki *et al.* [11] and Hashim *et al*. [12] reported that organic amendments, so used enhances soil fertility, plant nutrient status, saves cost of secondary- and micro-nutrients required for obtaining good yields and leads to less environmental pollution. Maman and Mason [13] concluded that integrated use of chemical fertilizers with organic manures has been found to be quite promising in maintaining high productivity and providing greater stability to crop production. Thumar *et al*. [14] found that the highest net realization was mainly because of higher productivity and better market prices. The differences in the B : C ratio is attributed to yield differences and varying costs when different organic manures were added. It is evident that organic manures such as FYM and bio-compost can be used in combination for more profitable income. Ismail *et al*. [15] stated that integrated use of inorganic and organic fertilizers should be employed to maximize economic yield and to improve soil health.

Therefore, the ultimate objective of this study was: to determine the best fertilization regimes used under the study that contribute to high productivity and enhanced quality of fodder millet as well as economic evaluation of studied treatments.

MATERIALS AND METHODS

Two field experiments were carried out at Kafr Al-Hamam, Agricultural Research Station during 2014 and 2015 summer seasons. Each experiment aimed to study the effect of mineral N, bio and organic fertilizers and their combinations on growth, forage yield and forage quality as well as economic evaluation of pearl millet (var. Shandaweel-1). The soil mechanical and chemical analyses of the experimental field soil are given in Table (1).

The experiment included seven treatments as follows:

T_1- Recommended mineral nitrogen fertilizer (120 kg N fad^{-1}) as control.
T_2- Bio-fertilizer (Nitrobine).
T_3- Organic fertilizer (3 ton compost fad^{-1}).
T_4- Mineral N (60 kg N fad^{-1}) + bio-fertilizer (Nitrobine).
T_5- Mineral N (60k g N fad^{-1}) + organic fertilizer (3 ton compost fad^{-1}).
T_6- Mineral N (60 kg N fad^{-1}) + organic fertilizer (6 ton compost fad^{-1}).
T_7- Bio-fertilizer (Nitrobine) + organic fertilizer (3 ton compost fad^{-1}).

A randomize complete block design with three replicates was used. The plot area was 10.5 m^2(3.5 x 3 m) *i. e.* 5 ridges each of 0.7 m width and 3m long. The preceding crop for both seasons was wheat (*Triticum aestivum* L.). Sowing dates were on 2nd and 8th June in the 1st and the 2nd seasons, respectively. Seeds were drilled in hills, 20 cm apart with 15 kg fad^{-1} seeding rate. Nitrogen fertilizer was applied in the form of ammonium nitrate (33.5% N) at the different rates under study and divided into equal doses. The first dose was added after 21 days from sowing, the second and the third doses were added

Table 1: Soil mechanical and chemical analyses of the experimental field during two summer successive seasons of 2014 and 2015

Soil characteristics	Season 2014	Season 2015
Mechanical analysis		
Find sand %	18.55	14.83
Silt %	26.80	28.95
Clay %	54.65	56.22
Texture	Clay	Clay
Chemical analysis		
PH	7.55	7.85
EC dS m^{-1}	2	2.3
Organic matter	1.42	1.20
Available macro nutrients (ppm)		
N	25.40	22.06
P	18.00	16,4
K	380.44	368.15

after the first and the second cuts, respectively. Each of calcium superphosphate (15.5% P_2O_5) at the rate of 150 kg fad^{-1} and potassium sulphate (48 % K_2O) at the rate of 50 kg fad^{-1} were applied before sowing. The bio-fertilizers used was Nitrobine. Nitrobine contains two non-symbiotic nitrogen fixing bacteria, *Azotobacter chroococcum* and *Azospirillum barasilense.* Were kindly provided by bio-fertilizers Production Unit; Soils, Water and Environment Research Institute, ARC, Giza, Egypt. They were prepared as inoculants on suitable sterilized carriers, packed into polyethylene bag (400 g per bag. Each bag content is 10^9 CFU/ g. for both inoculants). Gum Arabic was used as an adhesive agent to insure good contact with inoculation. Sown immediately and covered with the soil in order to minimize bacteria exposure to the sun. Care was taken to avoid cross contamination of inoculated and uninoculated seeds by planting the uninoculated seeds prior to inoculated seeds. The compost used was added before sowing by mixing it with the soil in each treated plot with compost according to the experimental treatments. The properties of this compost were: Weight of m^3 640 kg, humidity 29%, PH 7.4, EC dS m^{-1} 3.8, Organic matter 48.5%, Total nitrogen 1.27%, Total phosphorus 0.59% and Total potassium 0.78%.

The three cuts were taken in both seasons, the first cut was after 56 days of planting and the following cuts were done 35 days intervals in both seasons. The other agronomic practices were done as recommended.

At cutting time, plants of an area 4.2 m^2 were cut from the two inner ridges to determine the following parameters:

- Growth parameters: From each cut, 5 competitive plants of each sub-plot were taken to determine plant height (cm), number of leaves $plant^{-1}$, number of tillers $plant^{-1}$ and stem diameter (cm) as well as leaf area $plant^{-1}$ (cm^2).
- Fresh and dry forage yield (ton fad^{-1}): Forage yield was recorded in each cut. Representative samples from each treatment were taken at each cutting to determine the dry matter percentage. Data for fresh and dry forage yields as (ton fad^{-1}) (fad= faddan = 4200 m^2).
- Quality and nutritive values: Leaf/ stem ratio was estimated using the following formulae:

Dry weight of leaves/ plant ÷ Dry weight of stems/ plant x 100

Samples were taken at each cut from two replicates and dried and milled to fine powder at the three cuts for both seasons to determine crude protein content (CP%), crude fiber content (CF %), ether extract content (EE %) and ash (%) of whole plant following the conventional methods recommended by AOAC [16]. Nitrogen free extract (NFE %) it was calculated as follows: NEF (%) = 100- (CP % + CF % + EE %+ Ash content %). Total digestible nutrients was estimated as described by Church [17] : TDN % = [(50.41+1.04 CP) – (0.07 CF)]. The digestible crude protein (DCP %) was determined as DCP = [(CP x 0.9115) -3.62] according to Mcdonald *et al.* [18]. Also, the digestible energy value of forage was calculated according to Heaney and Pigden [19] : DE (K Cal /gm of dry matter)= 0. 546+ 0.055 (TDN %).

The CP %, CF %, ash %, NFE %, TDN % and DCP % were multiplied by the dry forage yield to calculated CP, CF, ash, NFE, TDN and DCP yields (kg fad^{-1}).

Economic Evaluation: The economic evaluation included the following three parameters:

- Average of input variables and the total costs of pearl millet production including fertilization treatments and other culture practices applied during the growth stages of pearl millet (*i.e.*, average land rent is not included)
- Net farm income of pearl millet for various fertilization treatments.
- Net farm return millet production as affected by applied treatments. It's calculated as the difference between the forage yield value (according to the actual price) and the total costs.

All fertilizers and seed prices and the costs of all farm operations are based on the official and the actual market prices determine by the Egyptian Ministry of Agriculture Anonymous [20]. Total costs included values of production tools and requirements such as seeds, fertilizers, irrigation, man, power, machinery and other general or different costs without land rent average.

Statistical Analysis: Data of each season were subjected to analysis of variance and the test of homogeneity of variance was done (Bartlett's test of homogeneity) and the combined analysis of both seasons of the three cuts were subjected to simple correlation and path analysis, as described by Gomez and Gomez [21]. The least significant differences (LSD) test at 0.05 levels was used to compare among means of treatments.

RESULTS AND DISCUSSION

Growth Parameters: The growth parameters, *i.e.* plant height, number of leaves plant^{-1}, number of tillers plant^{-1}, stem diameter and leaf area plant^{-1} (combined data) are presented in Table (2). Fertilization treatments significantly affected all growth parameters. Pearl millet fertilized at 60 kg N fad^{-1} + 6 ton compost fad^{-1} (T_6) produced the tallest plants (183.77, 166.53 and 136.87 cm), the highest number of leaves plant^{-1} (8.87, 7.33 and 7.37), the highest number of tillers plant^{-1} (9.67, 8.60 and 7.00), maximum stem diameter (1.53, 1.17 and 1.03 cm) and the largest leaf area plant^{-1} (1954.40, 1245.29 and 1056.38 cm^2) at the 1st, the 2nd and the 3rd cuts , respectively. In general, applied 60 kg N fad^{-1} + 6 ton compost fad^{-1} (T_6) were significantly superiority over recommended treatment (120 kg N fad^{-1}) (T_1) regarding the aforementioned traits. These increases in growth traits were more obvious when the compost was accompanied with N-fertilizer compared to either sole compost application (T_3) or sole 120 kg N fad^{-1} as N mineral (T_1). This treatment proved superior because compost application improves the soil-physical properties, hydraulic conductivity of the soil and also the availability of NPK which increased the plant growth. The superiority of this treatment over the rest of the combinations of fertilizers might also be due to higher availability of NO_3-N and production of growth-promoting substances. These results are in close conformity with those of Abd El-Lattief [22] found that application of organic fertilizer with mineral fertilizer significantly higher growth characters as (plant height, number of tillers plant $^{-1}$ and leaf area plant $^{-1}$). On the other hand, in all growth parameters and cuts, seeds inoculated by Nitrobine as bio-fertilizer without adding mineral N-fertilizer (T_2) produced the shortest plants (145.32, 147.97 and 119.93 cm), the fewest number of leaves (6.57, 5.67 and 5.27), the fewest number of tillers plant $^{-1}$ (8.03, 6.90 and 4.60), minimum stem diameter (0.99, 0.87 and 0.79 cm) and the smallest leaf area plant $^{-1}$ (1225.60 , 633.89 and 626.01 cm^2) for the 1st, 2nd and 3rd cuts, respectively compared with the control (T_1) or Nitrobine+ 60 kg N fad^{-1} (T_4) treatments. This reflect the impact role of N-mineral with bio-fertilizers which promoted plant growth compared to the bio-fertilizers alone, it could be attributed to the balanced supply of macro and micronutrients around the roots and the increase of water and nutrient absorption by the plants, due to the greater contact surface of the roots with the bio-fertilizers. These results are in a good connection with those reported by Alonso *et al*. [23]

Forage Yield (Ton Fad^{-1}): The results presented in Table (3) indicate significant differences in fresh and dry forage yields among all treatments for each cut and the total forage yield as combined data.

Results showed that higher forage yield was recorded by using (60 kg N fad^{-1}+ 6 ton compost fad^{-1}) (T_6) than the other treatments, which yielded 49.83 and 10.25 ton fad^{-1}, for the total fresh and dry forage yields, respectively. Average dry forage yield increases for treatment T_6, (60 kg N fad^{-1} + 6 ton compost fad^{-1}) relative to treatment T_1, 120 kg N fad^{-1}) as control were 54.44, 44.98 and 53.49 % in the 1st, 2nd and 3rd cuts, in respective order and the increase was 50.74 % in the total dry forage yield. This increase in forage yield with combined application of N- fertilizers and compost might be due to positive effects on soil physical and biochemical properties. It lowers soil bulk density, increases water holding capacity, CEC, build up beneficial soil microbes, improve good soil structure and enhance stable soil aggregates. These results are in agreement with those obtained by Patidar and Mali [24] they indicated that integrated use of chemical fertilizers with organic manures has been found to be quite promising in maintaining high productivity and providing greater stability to sorghum crop production. However, Rao *et al*. [25] found that, application of 5 ton FYM + 50 % recommended of NPK (100:50:60 kg ha^{-1}) significantly increased fresh and dry forage yields of sorghum. On the contrary, the statistical analysis revealed that the lowest values of each fresh and dry forage yields were produced by inoculation with Nitrobine (T_2), which

Table 2: Plant height (cm), number of leaves plant $^{-1}$, number of tillers plant $^{-1}$, stem diameter (cm) and leaf area plant $^{-1}$(cm^2) of pearl millet as influenced by fertilization treatments (combined data)

	Plant height(cm)			Number of leaves plant^{-1}			Number of tillers plant^{-1}			Stem diameter (cm)			Leaf area plant^{-1} (cm^2)		
Treatment	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
T_1	169.92	155.30	126.07	8.27	6.73	6.63	8.67	8.00	6.30	1.25	0.99	0.89	1605.59	941.84	826.75
T_2	145.32	147.97	119.93	6.57	5.67	5.27	8.03	6.90	4.60	0.99	0.87	0.79	1225.60	633.89	626.01
T_3	158.00	150.70	120.87	8.17	6.53	6.40	8.30	7.10	5.00	1.05	0.88	0.79	1656.01	917.45	819.44
T_4	163.77	153.37	128.10	8.17	6.70	6.73	8.63	7.70	5.80	1.14	0.97	0.85	1567.46	909.30	762.25
T_5	179.47	161.43	131.47	8.53	6.97	6.90	9.20	8.10	6.30	1.38	1.08	1.01	1826.07	1103.83	986.52
T_6	183.77	166.53	136.87	8.87	7.33	7.37	9.67	8.60	7.00	1.53	1.17	1.03	1954.40	1245.29	1056.38
T_7	172.77	159.13	129.73	8.43	7.10	7.08	9.27	8.23	6.43	1.38	1.06	0.92	1797.39	1125.51	927.22
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LSD 0.05	16.92	6.82	10.01	0.74	0.67	1.05	0.78	0.80	1.06	0.11	0.14	0.07	206.90	238.62	221.63

Where T_1 = 120 kgN fad^{-1}, T_2= Nitrobine , T_3= 3 ton compost fad^{-1}, T_4= 60 kg N fad^{-1}+Nitrobine , T_5= 60 kg N fad^{-1}+3 ton compost fad^{-1}, T_6= 60 kg N fad^{-1}+ 6 ton compost fad^{-1} and T_7= Nitrobine+ 3 ton compost fad^{-1} *= significant at 5% level.

Table 3: Fresh and dry forage yields (ton fad^{-1}) of pearl millet as influenced by fertilization treatments (combined data)

	Fresh forage yield (ton fad^{-1})				Dry forage yield (ton fad^{-1})			
Treatment	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total
T_1	13.57	11.76	7.59	32.93	2.59	2.49	1.72	6.80
T_2	9.57	9.60	5.35	24.53	1.82	2.02	1.18	5.01
T_3	11.67	10.67	6.33	28.67	2.21	2.24	1.40	5.85
T_4	12.02	11.57	7.10	30.70	2.29	2.45	1.57	6.31
T_5	16.43	13.79	8.85	39.07	3.14	2.90	2.07	8.11
T_6	21.03	17.19	11.61	49.83	4.00	3.61	2.64	10.25
T_7	16.76	13.50	9.18	39.44	3.18	2.83	2.06	8.07
F- test	*	*	*	*	*	*	*	*
LSD 0.05	2.08	1.35	1.30	4.30	0.39	0.28	0.25	0.83

Where T_1 = 120 kgN fad^{-1}, T_2= Nitrobine , T_3= 3 ton compost fad^{-1} , T_4= 60 kg N fad^{-1} +Nitrobine , T_5= 60 kg N fad^{-1} +3 ton compost fad^{-1}, T_6= 60 kg N fad^{-1} + 6 ton compost fad^{-1} and T_7= Nitrobine+ 3 ton compost fad^{-1} *= significant at 5% level

Table 4: Leaf/ stem ratio, protein yield (kg fad^{-1}), fiber yield (kg fad^{-1}) and ash yield (kg fad^{-1}) of pearl millet as influenced by fertilization treatments (combined data)

	Leaf/ stem ratio			Protein yield (kg fad^{-1})				Fiber yield (kg fad^{-1})				Ash yield (kg fad^{-1})			
Treatment	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total
T_1	1.21	1.03	0.51	340.48	283.04	167.84	791.36	848.23	716.06	504.21	2068.49	342.30	275.83	196.94	815.06
T_2	0.84	0.76	0.34	222.54	211.61	103.31	537.47	524.84	575.78	354.28	1454.90	235.99	221.08	142.27	599.34
T_3	1.10	0.87	0.49	270.81	235.39	134.53	640.73	623.63	672.55	473.45	1769.63	234.11	272.38	151.30	657.79
T_4	0.97	0.83	0.48	301.25	279.08	150.97	731.29	753.46	791.37	498.83	2043.66	253.53	271.97	171.97	697.46
T_5	1.21	1.09	0.51	412.17	355.39	217.23	984.80	887.44	881.96	621.89	2391.29	436.03	401.23	262.54	1099.80
T_6	1.26	1.61	0.62	524.87	441.84	277.54	1244.24	1092.52	1051.03	780.79	2924.34	442.52	504.60	292.42	1239.54
T_7	1.14	1.01	0.50	417.67	326.31	216.39	960.36	937.38	843.24	623.85	2404.47	402.96	350.18	258.09	1011.24
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LSD 0.05	0.13	0.41	0.13	53.36	38.83	25.25	108.49	94.63	80.32	70.99	217.70	40.21	47.50	23.86	98.31

Where T_1 = 120 kgN fad^{-1}, T_2= Nitrobine , T_3= 3 ton compost fad^{-1} , T_4= 60 kg N fad^{-1}+Nitrobine , T_5= 60 kg N fad^{-1}+3 ton compost fad^{-1}, T_6= 60 kg N fad^{-1}+ 6 ton compost fad^{-1} and T_7= Nitrobine+ 3 ton compost fad^{-1} *= significant at 5% level.

Table 5: Nitrogen free extract yield (kg fad^{-1}), total digestible nutrients yield (kg fad^{-1}), digestible crude protein yield (kg fad^{-1}) and digestible energy (K Cal/ g DM) of pearl millet as influenced by fertilization treatments (combined data)

	NFE (kg fad^{-1})				TDN yield (kg fad^{-1})				DCP yield (kg fad^{-1})				DE (K Cal/ g DM)		
Treatment	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut
T_1	1039.08	1189.36	837.77	3066.22	1427.80	1424.74	967.34	3819.88	222.75	171.37	89.19	483.31	3.72	3.66	3.60
T_2	818.04	989.53	571.44	2379.02	1045.31	1151.97	655.27	2852.55	140.43	121.72	51.24	313.39	3.57	3.48	3.42
T_3	1062.67	1032.35	626.00	2721.01	1282.85	1258.12	739.99	3280.96	170.88	135.41	72.51	378.80	3.69	3.66	3.55
T_4	966.37	1087.12	732.89	2786.38	1260.97	1343.15	854.07	3458.18	197.08	168.96	81.36	447.41	3.64	3.65	3.54
T_5	1375.27	1234.74	948.98	3558.98	1830.14	1637.42	1160.00	4627.55	269.66	224.26	124.96	618.87	3.76	3.67	3.64
T_6	1900.01	1573.66	1268.72	4742.39	2357.72	2068.88	1492.07	5918.67	343.39	278.81	159.65	781.84	3.79	3.71	3.67
T_7	1394.08	1281.23	944.59	3619.91	1826.56	1602.83	1152.27	4581.66	273.25	200.55	124.48	598.27	3.70	3.65	3.60
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LSD 0.05	202.62	115.70	123.36	400.76	237.16	164.69	139.77	493.91	33.48	25.06	14.86	68.20	0.11	0.10	0.13

Where T_1 = 120 kgN fad^{-1}, T_2= Nitrobine , T_3= 3 ton compost fad^{-1} , T_4= 60 kg N fad^{-1} +Nitrobine , T_5= 60 kg N fad^{-1} +3 ton compost fad^{-1}, T_6= 60 kg N fad^{-1} + 6 ton compost fad^{-1} and T_7= Nitrobine+ 3 ton compost fad^{-1} *= significant at 5% level.

+Table 6: Estimates of costs for inputs farm operations and economic return of pearl millet as affected by fertilization treatments across the two growing seasons of 2014 and 2015

	Treatment						
Costs of production inputs	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Land preparation tillage	550.00	550.00	550.00	550.00	550.00	550.00	550.00
Planting	200.00	200.00	200.00	200.00	200.00	200.00	200.00
Seeds	360.00	360.00	360.00	360.00	360.00	360.00	360.00
Irrigation	720.00	720.00	720.00	720.00	720.00	720.00	720.00
Mineral fertilizer							
N	300.00	-	-	150.00	150.00	150.00	150.00
P	150.00	150.00	150.00	150.00	150.00	150.00	150.00
K	200.00	200.00	200.00	200.00	200.00	200.00	200.00
Bio-fertilizer	-	16.00	-	16.00	-	-	16.00
Compost	-	-	200.00	-	200.00	400.00	200.00
Hoeing and weeding	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Harvesting	800.00	800.00	800.00	800.00	800.00	800.00	800.00
Total variable cost	3880.00	3596.00	3780.00	3746.00	3930.00	4130.00	3946.00
Yield ton $fad^{-1.}$	28.67	24.53	32.93	30.70	39.07	49.83	39.44
Price ton fad^{-1}	300.00	300.00	300.00	300.00	300.00	300.00	300.00
Total revenue	8601.00	7359.00	9879.00	9210.00	11721.00	14949.00	11832.00
Net return	4721.00	3763.00	6099.00	5464.00	7791.00	10819.00	7886.00
Return invested L.E.	2.22	2.05	2.61	2.46	2.98	3.62	3.00
Net return of invested L.E.	1.22	1.05	1.61	1.46	1.98	2.62	2.00

Where T_1 = 120 kgN fad^{-1}, T_2= Nitrobine , T_3= 3 ton compost fad^{-1} , T_4= 60 kg N fad^{-1} +Nitrobine , T_5= 60 kg N fad^{-1} +3 ton compost fad^{-1}, T_6= 60 kg N fad^{-1} + 6 ton compost fad^{-1} and T_7= Nitrobine+ 3 ton compost fad^{-1} .

Net return (L.E. fad^{-1}) = Total revenue - Total variable cost Return of invested = Total revenue / Total variable cost. Net return of invested L.E.= Return of invested L.E. -1

yielded 24.53 and 5.01 ton fad^{-1}, respectively. Whereas, using inoculation by the Nitrobine only caused significantly decreased of dry forage yield by 29.73, 18.88 and 31.40 % in the 1st, 2nd cut and 3rd cuts, in respective order, and the increase was 26.32 % in the total dry forage yield compared to the control (120 kg N fad^{-1}), respectively. The reduction in fresh and dry forage yields due to using bio-fertilizers instead of mineral fertilizers is not sufficient whereas using of bio-fertilizers increased the efficiency of mineral fertilizers. However, by low using of mineral fertilizers, maximum forage yield achieved. Similar results were obtained by Sardrood *et al*. [26] and Maman and Mason [13].

Quality and Nutritive Values: The leaf/ stem ratio and the chemical composition as influenced by different fertilization treatments of pearl millet as combined analysis are presented in Tables (4 and 5).

The statistical analysis of variance showed significant differences among the seven treatments. This was true in the three individual cuts and their total for nutritive values. In general the treatment T_6 which applied (60 kg N fad^{-1} + 6 ton compost fad^{-1}) gave the highest values of each of leaf/ stem ratio (1.26 in the 1st, 1.61 in the 2nd and 0.62 in the 3rd cuts), total crude protein, crude fiber, ash, nitrogen free extract (NFE), total digestible nutrients (TDN) and digestible crude protein (DCP) yields (1244.24, 2924.34, 1239.54, 4742.39, 5918.67 and 781.84 kg fad^{-1}), respectively. Whereas, this treatment significantly increased total crude protein yield, total crude fiber yield, total ash yield, total NFE yield, total TDN yield and total DCP yields by 57.23, 41.38, 52.08, 54.67, 54.94 and 61.77 % compared to control treatment (120 kg N fad^{-1}) (T_1), respectively. These increases which obtained with integrated add of N-fertilizer + organic farmyard, may be due to increasing photosynthetic surface area which capture the incident light more efficiently, metabolic processes and hence more production and accumulation of assimilates in plants which in turn led to increase total dry matter production accumulation and partitioning. This might have directly contributed to large photosynthetic activity and synthesis of higher protein, fiber, ash, NEF yields. Also, increasing leaf/ stem ratio with this treatment may due to the fact that, among the aerial plant parts, the leaves are more responsive to supply of available N from mineral and organic fertilizers than stems. Moreover, the lowest values for these parameters obtained by using inoculation with Nitrobine only. Similar conclusion was recorded by Gupta *el al*. [27] and Kumar and Sharma [28] they stated that use of organic fertilizer together with mineral N-fertilizers, compared to the addition of organic or mineral fertilizers alone, had a higher positive effect on microbial biomass and improved quality of fodder sorghum varieties. Likewise, applying (60 kg N fad^{-1} + 6 ton compost fad^{-1}) exerted a pronounced effect on the digestible energy of forage of the three cuts. The positive effect was more marked on the early cut. It is evident that the 1st cut produced higher CP and digestible energy than the 2nd and the 3rd cuts. Also, the increase in TDN and DCP yields resulted mainly from the increase in dry forage yield rather than the increase in protein and fiber contents. These results further substantiate those found by hassan [29].

Economic Evaluation: Results in Table (6) showed that the highest net return, dis-including land rent, (10819 L.E.) was achieved by treatment (60 kg N fad^{-1} + 6 ton compost fad^{-1}) (T_6), followed by treatment (Nitrobine + 3 ton compost fad^{-1}) (T_7) (7886 L.E.) then treatment (60 kg N fad^{-1} + 3 ton compost fad^{-1}) (T_5) (7791 L.E.). While, the treatment (Nitrobine) (T_2) had the lowest net return and net return of invested Egyptian pound.

CONCLUSION

The present work of pearl millet indicated that treatment 60 kg N fad^{-1} + 6 ton compost fad^{-1} (T_6) could be recommended to produce a better feed quantitively, qualitatively and economically as well as decreasing hazard environmental effects that may be caused by mineral N- fertilizer under this study.

ACKNOWLEDGMENT

The author wishes to express his deep gratitude to Prof. Dr. Mahmud Abd El Halim, Central laboratory for statistical analysis for his great effort and helpful assistance in the Economic study.

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