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EFFECT OF NITROGEN AND ZINC LEVELS ON YIELD AND ECONOMICS OF FODDER PEARL MILLET (*PENNISETUM AMERICANUM* L.)

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SUMMARY

A field experiment was conducted on fodder pearl millet during **kharif** season of 2014 at Instructional Farm, College of Agriculture, S. K. Rajasthan Agricultural University, Bikaner situated in arid western hyper arid zone of Rajasthan. The treatments consisted of five nitrogen levels viz., 0, 30, 60, 90 and 120 kg N/ha and four zinc levels viz., 0, 15, 30 and 45 kg $ZnSO_4$/ha. The experiment was laid out in randomized block design (Factorial) with three replications. The results showed that maximum green fodder (196.61 and 184.21 q/ha) and dry matter (33.36 and 29.33 q/ha) yield of fodder pearl millet at first and second cut, respectively; and economics viz. net return (Rs. 57,117/ha) and B : C ratio (4.02) were recorded with 120 kg N/ha. Further, significant increase in green fodder (347.21 q/ha) and dry matter (55.46 q/ha) yield; and economics viz., net returns (Rs. 50,700/ha) and B : C ratio (3.69) were obtained when the crop was fertilized with 30 kg $ZnSO_4$/ha compared with control and 15 $ZnSO_4$ kg/ha.

Key words : Dry matter yield, green fodder yield, net returns, nitrogen levels, zinc levels

Pearl millet (*Pennisetum americanum* L.) is one of the most important crops which grows in the arid and semi-arid areas in the world for both food and forage production (Arya *et al.*, 2013). It is nutritious and palatable and can be fed as green, dry or as conserved fodder in the form of silage or hay. It is adapted to drought and poor soil fertility, but responds well to good management and higher fertility levels. The millet has great potential to supply nutritious fodder in areas characterized by moisture deficient and have comparatively higher temperature. Optimum growth of forage crops can only be achieved if adequate supplies of plant nutrients are present in the soil. Efficient fertilizer management plays an important role in increasing the crop yield through efficient utilization of limited source of moisture supply. The soils of arid and semi-arid areas are deficient in various nutrient elements especially in nitrogen and zinc.

Nitrogen is an essential primary nutrient for profuse plant growth and plays a pivotal role in productivity of forage. Application of nitrogen to fodder crops is the most important way to increase forage production. Although the optimization of nitrogen fertilization is an important aspect in making pearl millet fodder production cost-effective, use of nitrogen in excess leads to deterioration of soil health and accumulation of nitrate-N in fodder which is toxic to animals. The toxic effects of nitrate on ruminants are well known.

During past three and a half decade, micro-nutrients have occupied an important place in Indian agriculture and have become indispensible to the productivity of crop. Zinc is an essential micro-nutrient and it is a well known fact that zinc is now considered as fourth most important yield-limiting nutrient after nitrogen, phosphorus and potassium (Maclean *et al.*, 2002). It plays indispensable role in various plant physiological processes such as photosynthesis, protein and sugar synthesis, fertility and production of seeds, growth regulation and disease immune system. Therefore, an attempt was made to increase the productivity of pearl millet with different nitrogen and zinc levels.

MATERIALS AND METHODS

A field experiment was conducted on fodder

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pearl millet during **kharif** season of 2014 at Instructional Farm, College of Agriculture, S. K. Rajasthan Agricultural University, Bikaner situated in arid western hyper arid zone of Rajasthan. The soil was sandy loam in nature, having pH (1 : 2) 8.4, electrical conductivity (1 : 2) 0.20 dS/m, organic carbon 0.11 per cent and available N, P and K were 93.85, 21.91 and 234.0 kg/ha, respectively. The experiment was laid out in randomized block design (Factorial) with three replications. The treatments consisted of five nitrogen levels viz., 0, 30, 60, 90 and 120 kg N/ha and four zinc levels viz., 0, 15, 30 and 45 kg $ZnSO_4$/ha. Sowing of fodder pear millet variety AVKB-19 was done manually with kera method on 24 July 2014 with the onset of monsoon rain at row spacing of 25 cm using seed rate of 10 kg/ha. Full dose of $ZnSO_4$ and one-third dose of nitrogen (as per treatment) was applied as basal and remaining two-third dose of nitrogen was top dressed in two splits equally i. e. first at 25 DAS and rest dose after about one week of first cutting (50 DAS). Plant population was recorded by counting number of plants per metre row length from three randomly selected spots in each plot at 25 DAS and at harvest. These were averaged to work out number of plants per metre row length. For green fodder, crop was harvested at 45 and 90 DAS. First two rows as half metre from either side as border from each plot were harvested. Then crops were harvested from each net plot area individually, tagged and weighed. Weight was recorded and expressed in kg/ha. Then it was converted into green fodder yield (q/ha). Dry matter yield (q/ha) was taken from samples of fresh weight after complete drying or on the basis of the moisture content in biomass at cutting, putting sample in oven at 72^0C for 24 h.

RESULTS AND DISCUSSION

Nitrogen Levels

Studies on nitrogen levels indicated that green fodder and dry matter yield; and economics of fodder pearl millet were significantly influenced by different nitrogen levels, however, plant population was not affected by nitrogen levels. Maximum green fodder (196.61 and 184.21 q/ha) and dry matter (33.36 and 29.33 q/ha) yield of fodder pearl millet at first and second cut, respectively; and economics viz., net returns (Rs. 57,117/ha) and B : C ratio (4.02) were recorded with 120 kg N/ha. However, 90 and 120 kg N/ha gave at par values of green fodder and dry matter yield; and net returns of fodder pearl millet (Table 1). This may be mainly attributed to positive influence of nitrogen on the growth of crop, which ultimately led to realization of higher fodder yield. Further, the beneficial effects of nitrogen on cell division and elongation, formation of nucleotides and co-enzymes which resulted in increased meristematic activity and

TABLE 1
Effect of nitrogen and zinc levels on plant population, yield and economics of fodder pearl millet

Treatment	Plant population/ meter row length		Green fodder yield (q/ha)			Dry matter yield (q/ha)			Net returns (Rs./ha)	B : C ratio
	25 DAS	90 DAS	1st cut	2nd cut	Total	1st cut	2nd cut	Total		
Nitrogen levels (kg/ha)										
N_0	14.62	12.16	134.33	119.99	254.33	20.25	15.54	35.79	33,403	2.92
N_{30}	14.85	12.35	160.84	144.08	304.92	23.83	19.13	42.96	43,126	3.40
N_{60}	14.93	12.41	176.59	156.98	333.58	27.60	22.90	50.50	48,461	3.64
N_{90}	15.00	12.47	190.93	178.72	369.65	32.91	28.21	61.12	54,816	3.97
$N_{12}0$	15.02	12.48	196.61	184.21	380.82	33.36	29.33	62.69	57,117	4.02
S. Em±	0.33	0.23	2.55	3.83	5.96	1.08	0.64	1.18	1,188	
C. D. (P=0.05)	NS	NS	7.29	10.97	17.07	3.08	1.83	3.38	3,400	
$ZnSO_4$ levels (kg/ha)										
Zn_0	14.90	12.39	152.69	142.78	295.47	23.17	19.01	42.17	41,931	3.50
Zn_{15}	14.88	12.37	169.70	154.74	324.44	26.16	21.46	47.62	47,120	3.64
Zn_{30}	14.90	12.39	182.63	164.58	347.21	30.08	25.38	55.46	50,700	3.69
Zn\	14.85	12.35	182.43	165.09	347.52	30.95	26.24	57.19	49,787	3.52
S. Em±	0.29	0.21	2.28	3.43	5.33	0.96	0.57	1.05	1,062	
C. D. (P=0.05)	NS	NS	6.52	9.81	15.27	2.75	1.63	3.02	3,041	

NS–Not Significant.

photosynthetic area and hence more production and accumulation of photosynthates, yielding higher green fodder and dry matter. These results are in conformity with the findings of Sharma and Verma (2005) and Sheoran and Rana (2006).

Zinc Levels

Significant increase in green fodder (347.21 q/ha) and dry matter (55.46 q/ha) yield; and economics viz., net returns (Rs. 50,700/ha) and B : C ratio (3.69) were obtained when the crop was fertilized with 30 kg $ZnSO_4$/ha compared with control and 15 $ZnSO_4$ kg/ha dose, however, it was found at par with 45 kg $ZnSO_4$/ha (Table 1). The fodder yield, being a function of the cumulative effect of growth parameters such as plant height and dry matter accumulation per plant, resulted in higher forage yield under this treatment. The results are in close conformity with the findings of Kheshwa and Jat (1992) and Dhadich and Gupta (2005) who reported significantly increased green fodder and dry matter yield with application of 10 kg $ZnSO_4$/ha.

TABLE 2
Interaction effect of nitrogen and zinc levels on total green fodder yield (q/ha)

Treatment	N_0	N_{30}	N_{60}	N_{90}	N_{120}
Zn_0	238.25	246.75	261.58	350.69	380.07
Zn_{15}	254.75	289.13	330.53	354.86	392.91
Zn_{30}	261.58	335.41	357.71	392.01	389.36
Zn_{45}	262.74	348.40	384.48	381.06	360.92
S. Em±	11.93	-	-	-	-
C. D. (P=0.05)	34.15	-	-	-	-

TABLE 3
Interaction effect of nitrogen and zinc on net returns (Rs./ha)

Treatment	N_0	N_{30}	N_{60}	N_{90}	N_{120}
Zn0	31649.33	32954.21	35524.75	51093.90	58430.67
Zn15	33974.39	40455.24	48338.87	52809.33	60023.67
Zn30	34366.00	48735.33	52799.33	59263.60	58338.00
Zn45	33623.00	50358.07	57179.80	56098.66	51675.80
S.Em±	2375.17	-	-	-	-
C. D. (P=0.05)	6799.93	-	-	-	-

Interaction Effect of Nitrogen and Zinc

Pearl millet green fodder yield and net returns were significantly influenced by nitrogen x zinc fertilizer levels. The highest total green fodder yield (392.91 q/ha) and net returns (Rs. 60023.67/ha) were recorded with 120 kg N/ha and 15 kg $ZnSO_4$/ha treatment followed by 90 kg N/ha and 30 kg $ZnSO_4$/ha treatment (Tables 2 and 3). Such type of findings were also reported by Khourgami and Bour (2008) in wheat, Bhoya *et al.* (2013) in sorgham and Sajad *et al.* (2014) in maize which reported positive interaction between nitrogen and zinc fertilization at lower levels.

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