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EFFECT OF INTEGRATED NITROGEN MANAGEMENT ON GROWTH, YIELD AND ECONOMICS OF MAIZE

Aparna. M. Yadav[1], V. G. Nagdeote[2], V.G. Raut[3] and I. M. Nagrare[4]

ABSTRACT

An experiment was conducted at College of Agriculture, Nagpur to study the effect of integrated nitrogen management on growth, yield and economics of maize using different organic and inorganic fertilizer during *kharif* season of 2015-16 in randomized block design with three replications. The treatments included T_1-100% N through urea,T_2-100% N through neem coated urea,T_3- 75% N through urea + 25% N through FYM,T_4-75% N through urea + 25% N through vermicompost,T_5-75% N through urea + 2% spray of urea (at flowering and grain filling stage),T_6-75% N through urea + 25% N through neem coated urea,T_7-50% N through urea + 50% N through neem coated urea,T_8-50% N through urea + 25% N through FYM + 25% N through neem coated urea ,T_9-50% N through urea + 25% N through vermicompost + 25% N through neem coated urea. The results of the study indicated that application of 100% N through neem coated urea recorded higher growth, yield attributing characters viz., Plant height, leaf area plant^{-1}, dry matter plant^{-1} , grain yield plant^{-1}, test weight, seed and straw yield (q ha^{-1}). GMR, NMR and B:C ratio were significantly more in the treatment 100% N through neem coated urea.

(Key words: Maize, nitrogen, growth , yield and economics)

INTRODUCTION

Maize (*Zea mays* L.) is one of the important cereal crop of the world, known as "Queen of cereals" due to its great importance in human and animal diet, very efficient utilizer of solar energy and has immense potential for higher yield.

Maize is known for its wider adaptability and multipurpose uses as food, feed, fodder and industrial products. More than 35 products of daily use are derived from maize viz., starch, lactic acid, glucose, acetic acid, dextrose, sorbitol, dextrine, high fructose syrup, maltodextrine, germ oil, germ application in industries such as alcohol, textile, paper, pharmaceuticals, organic chemicals, cosmetics and edible oils.

Among different essential nutrients, N is highly limiting in Indian soils that exerts a profound effect on plant growth and development owing to its metabolic and physiological needs. Chemical fertilizers can not be avoided completely since they are the potential sources of high amount of nutrients in easily available form. Most of the crops respond quickly to chemical fertilizers and gave higher yield as the maize is more responsive to fertilizers. But continuous application of chemical fertilizers alone is not desirable as it has been reported to deteriorate soil health. At the same time application of organic manures alone do not produce required yields due to their low nutrient status. Sustainable yield levels could be achieved by applying appropriate combination of organic and chemical fertilizers (Verma, 1991 and Obi and Ebo,1995). Considering the above facts present investigation was undertaken to study the effect of integrated nitrogen management on growth, yield and economics of maize.

MATERIALS AND METHODS

A field experiment was conducted at Agronomy farm, College of Agriculture, Nagpur during *kharif* season of 2015-16. The experiment was laid out in randomized block design with three replications.The treatments consisted of T_1-100% N through urea,T_2-100 % N through neem coated urea,T_3- 75% N through urea + 25% N through FYM, T_4-75% N through urea + 25% N through vermicompost, T_5-75% N through urea + 2% spray of urea (at flowering and grain filling stage), T_6-75% N through urea + 25% N through neem coated urea, T_7-50% N through urea + 50% N through neem coated urea,T_8-50% N through urea + 25% N through FYM + 25% N through neem coated urea,T_9-50% N through urea + 25% N through vermicompost + 25% N through neem coated urea. The soil of experimental plot was clayey in texture, low in available nitrogen (250.63 kg ha^{-1}), medium in phosphorus (20.32 kg ha^{-1}) and organic carbon (0.52 %) and very high in available potash (414.42 kg ha^{-1}) and slightly alkaline in reaction (pH 7.60).

The crop variety PKVM- Shatak was used with gross plot size of 5.4 m ×4.8 m and net plot size of 4.8 m × 3.4 m. As per the treatment, the quantity of FYM, vermicompost and fertilizer required plot^{-1} was calculated. FYM, vermicompost were applied before sowing. Nitrogen was applied as per treatments in three splits i.e.$^1/_2$at sowing,$^1/_4$ at 30 DAS and $^1/_4$ at 50 DAS.Full dose of phosphorus,

1 & 3. P.G. Students, Agronomy section, College of Agriculture, Nagpur (M.S.)
2 & 4. Assoc. Professors, Agronomy section, College of Agriculture, Nagpur (M.S.)

potassium were applied at sowing. In order to represent the plot, five plants of maize from each net plot were selected randomly, labeled properly. The growth attributing characters *viz.,* plant height, leaf area plant^{-1} and dry matter accumulation plant^{-1} were recorded at 30,60,90 DAS and at harvest and yield attributing characters and yield *viz.,* number of grains cob^{-1}, grain yield plant^{-1},test weight, seed and straw yield (kg ha^{-1}) were also recorded at harvest.The gross monetary and net monrtary returns along with B:C ratio were calculated.

RESULTS AND DISCUSSION

Effect of Integrated nitrogen management on crop growth

The data pertaining to various crop growth studied viz., plant height, leaf area and dry matter accumulation plant^{-1} as influenced by various treatments are presented in table 1. Plant height, leaf area and dry matter accumulation plant^{-1} were significantly more in100% N through neem coated urea (T_2) followed by 50% N through urea + 50% N through neem coated urea (T_7) and 75% N through urea + 25% N through neem coated urea (T_6) and 100% N through urea (T_1) .

This might be due to use of readily availability of nitrogen through the inorganic fertilizers in adequate quantity at proper stage and resulted in optimum cell division and cell enlargement which ultimately enhanced the plant height, leaf area plant^{-1} and dry matter accumulation plant^{-1}. Hussaini *et al.*(2001) reported that application of 120 kg N ha^{-1} significantly increased the plant height, total leaf area and leaf area index in maize. Roogtanakiat *et al.*(2000) reported that sweet corn showed maximum growth, increased plant height and dry matter production when fertilized with 75:75:75 NPK ha^{-1}.Harikrishna *et al.*(2005) reported that application of 200% RDN in two, three and four splits recorded significantly higher plant height, LAI, dry matter yield in maize.

Effect on yield attributes

Data pertaining to various yield attributes viz., number of cobs plant^{-1}, number of grains cob^{-1}, grain yield plant^{-1} and test weight as influenced by different treatments are presented in table 2 indicated that cobs bearing plant^{-1} were not influenced significantly by different treatments. Among various treatments application of 100% N through neem coated urea recorded maximum number of grains cob^{-1}, grain yield plant^{-1} and test weight over rest of the nitrogen treatments followed by application of 50% N through urea+50% N through neem coated urea (T_7), 75% N through urea + 25% N through neem coated urea (T_6) and 100% N through urea (T_1). All the nitrogen management treatments significantly improved the yield attributes. This was because of improvement in growth characteristics as a consequence of nitrogen management treatments. Itnal and Palled (2001) reported that application of 100% RDN recorded higher weight of cob, number of grains cob^{-1}, grain weight and 100 grain weight in maize crop when compared with 50% RDN and no nitrogen application.

Sahoo and Mahaptra (2004) reported that increase in levels of N increased the number of green cobs, length and weight of green cob and yield of fresh grains.The increase in cob yield was directly contributed by the weight of individual cob and cobs ha^{-1}. The fresh weight of cob was maximum (201 g cob^{-1}) with the application of 180 kg N ha^{-1} which was at par with 120 kg N ha^{-1}. They also reported that the yield of green cob did not increase significantly beyond 120 kg N ha^{-1}.

Effect on yield

Data in table 2 indicated that grain yield and straw yield, significantly affected by various treatments. All the nitrogen management treatments significantly improved grain yield and straw yield. Treatment T_2 (100% N through neem coated urea) registered significantly higher grain yield (54.15 q ha^{-1}) and straw yield (81.25 q ha^{-1}), which proved significantly superior to other treatments followed by application of 50% N through urea + 25% N through neem coated urea (T_7) and application of 75% N through urea + 25% N through neem coated urea (T_6).The increase in grain and straw yield was related to the availability of nutrient mainly nitrogen by neem coated urea helped in reducing leaching and volatilization losses thereby accelerated the availability. Usha Rani *et al.*(2013) found that application of neem cake @1t ha^{-1} accompanied with a chemical fertilizers (168 kg N, 100 kg P_2O_5 100 kg K_2O ha^{-1} for plant crop and 280 kg N, 100 kg P_2O_5 100 kg K_2O ha^{-1} for plant crop and 280 kg N, 100 kg P_2O_5 and 168 kg K_2O ha^{-1} for ratoon crops) which produced mean cane yield of 102.2 t ha^{-1}and 122.8 t ha^{-1}, 91.8 t ha^{-1}, 90.65 t ha^{-1} in plant crop (1st, 2nd) and first, second ratoon crops respectively. Ramteke *et al.* (2014) reported that seed cotton yield (16.77 q ha^{-1}) and straw yield (36.01 q ha^{-1}) found highest in RDF (100:50:50 kg ha^{-1}) followed by the treatment T_6 which contains 25% RDF with FYM @2.5t ha^{-1} blended with 2% urea and 5% SSP +3 foliar sprays of 2% urea at critical stages of crop like square formation, flowering and boll development. Tanwar (2014) studied that application of 100% RDN through neem coated urea (4ml neem oil 100^{-1} g urea) significantly increased both grain (69.10 q ha^{-1}) and stover yield (80.17 q ha^{-1}) of maize over all treatments.

Economic studies

Data on gross monetary return, net monetary return and B:C ratio as affected by various nitrogen treatments are presented in table 2.

Perusal of the data indicated that GMR (87999ha^{-1}) and NMR (61099 ha^{-1}) were significantly higher in 100% N through neem coated urea (T_2). Among various treatments highest GMR (87999 ha^{-1}), NMR (61099 ha^{-1}) and B:C ratio (3.27) were recorded by the application of 100% N through neem coated urea (T_2) followed by the application of 50% N through urea + 50% N through neem coated urea (T_7) and application of 75% N through urea + 25% N through neem coated urea (T_6).

Anil kumar *et al.* (2002) noticed that application of 150% RDF ha^{-1} to maize resulted in the maximum NMR and B:C

Table 1. Effect of integrated nitrogen management on growth of maize

Treatments	Plant height (cm)				Leaf area plant^{-1} (dm^2)				Dry matter accumulation plant^{-1} (g)			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1- 100% N through urea	34.75	121.82	210.75	211.40	26.13	53.60	65.18	64.10	29.34	62.44	123.36	126.01
T_2- 100% N through neem coated urea	39.01	127.35	215.40	217.41	27.21	56.17	69.27	67.52	32.40	66.25	127.66	130.60
T_3- 75% N through urea+25% N through FYM	27.50	106.45	174.25	176.25	22.61	44.32	56.46	54.16	25.49	52.95	109.34	114.44
T_4- 75% N through urea+25% N through vermicompost	29.56	110.49	188.65	191.23	22.67	45.50	57.49	55.24	26.57	56.62	111.20	116.33
T_5- 75% N through urea+2% spray of urea (at flowering and grain filling stage)	33.10	114.80	194.66	195.20	25.51	48.86	61.20	58.22	28.31	59.60	116.40	119.20
T_6- 75% N through urea+25% N through neem coated urea	35.50	123.37	212.23	213.28	26.92	54.18	67.64	65.18	30.52	64.17	125.33	128.84
T_7- 50% N through urea+50% N through neem coated urea	37.83	125.54	213.44	215.06	27.01	55.23	68.25	66.47	31.60	65.71	126.45	129.34
T_8- 50% N through urea+25% N through FYM+25% N through neem coated urea	31.26	111.48	189.38	192.46	23.61	46.64	58.48	56.23	27.28	57.66	114.47	117.49
T_9-50% N through urea+25% N through Vermicompost +25% N through neem coated urea	32.31	113.12	193.60	194.34	24.21	47.75	60.13	57.65	28.00	58.32	115.33	118.25
S E (m)±	2.53	3.76	6.33	6.62	1.30	1.97	2.41	2.21	1.56	2.09	3.74	3.77
C D at 5%	-	11.28	18.99	19.86	-	5.88	7.23	6.63	-	6.27	11.22	11.31
GM	33.43	117.16	199.15	200.55	25.10	50.25	61.73	60.53	28.83	60.07	118.83	122.27

Table 2. Effect of integrated nitrogen management on yield contributing parameters , yield, and economics of maize

Treatments	Cob bearing plant^{-1}	No. of grains cob^{-1}	Grain yield plant^{-1} (g)	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	GMR	NMR	B:C ratio
T_1- 100% N through urea	1.60	336.42	80.24	26.61	49.52	72.29	79175	53775	3.11
T_2- 100% N through neem coated urea	1.66	388.20	88.20	28.20	54.15	81.25	87999	61099	3.27
T_3- 75% N through urea+25% N through FYM	1.11	262.54	67.30	24.25	43.62	58.65	69527	31687	1.83
T_4- 75% N through urea+25% N through vermicompost	1.20	278.62	70.12	24.45	45.85	60.50	72851	34171	1.88
T_5- 75% N through urea+2% spray of urea (at flowering and grain filling stage)	1.50	326.82	78.36	26.12	48.10	68.30	77393	52040	3.05
T_6- 75% N through urea+25% N through neem coated urea	1.61	364.16	82.15	27.05	50.78	74.64	82212	56562	3.20
T_7- 50% N through urea+50% N through neem coated urea	1.63	372.14	84.22	27.13	51.40	76.07	83319	57493	3.22
T_8- 50% N through urea+25% N through FYM+25% N through neem coated urea	1.23	298.20	73.90	25.41	46.50	65.10	73928	34978	1.89
T_9-50% N through urea+25% N through Vermicompost+25% N through neem coated urea	1.40	319.44	76.90	25.70	47.22	64.21	75976	36126	1.90
S E (m) ±	0.07	12.88	2.84	0.76	2.08	4.06	3010	3010	-
C D at 5%	0.21	38.63	8.51	2.27	6.24	12.18	9030	9030	-
GM	1.43	326.72	77.93	26.10	48.37	68.40	78042	46436	2.59

ratio. Dubey *et al.*(2006) reported that net return and B:C ratio were found maximum (Rs.52663 and 2.65, respectively) with the application of 100% kg N ha^{-1}due to higher grain and stover yield.

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