E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(1): 144-148
Received: 17-11-2023
Accepted: 20-12-2023

Rathod SK
Navsari Agricultural University, Navsari, Gujarat, India

Patel VM
Navsari Agricultural University, Navsari, Gujarat, India

Corresponding Author:
Rathod SK
Navsari Agricultural University, Navsari, Gujarat, India

Response of *rabi* maize (*Zea mays* L.) to fertilizer application and organic liquid spray under South Gujarat condition

Rathod SK and Patel VM

DOI: https://doi.org/10.33545/2618060X.2024.v7.i1b.202

Abstract
A field experiment was carried out at College Farm, Navsari Agricultural University, Navsari on clayey soils during *rabi* season of 2017-18 to study the "Response of *rabi* maize (*Zea mays L.*) to fertilizer application and organic liquid spray under south Gujarat condition". The experiment comprising of twelve treatment combinations and it is randomized three times. Recommended dose of fertilizer recorded significantly higher growth and yield attributes *viz*., plant height, dry matter accumulation/plant, number of leaves/plant, leaf area/plant, number of cobs/plant, number of grains/cob, cob length and girth, cob weight, test weight, shelling% as well as yields of *rabi* maize, but it remained at par with treatment 75% RDF. Application of 2% foliar spray of banana pseudo stem enrich sap recorded significantly higher growth as well and yield attributing characters and yields of *rabi* maize. Most of all the growth attributes, yield attributes and yields of maize recorded significantly higher under two sprays of organic liquid at 30 and 40 DAS over one spray of organic liquid at 30 DAS.

Keywords: Banana pseudo stem sap, recommended dose of fertilizer, *Rabi* maize

Introduction
Maize (*Zea mays* L.) the "Queen of Cereals", popularly known as corn, is one of the most important cereals of the world, ranking third among the food crop, next to rice and wheat, both in respect of area and production. Nutrients applied in RDF are nitrogen and phosphorus from which Nitrogen is the key element in crop growth and is the most limiting nutrient in Indian soil. The paramount importance of nitrogen for increasing the yield has been widely accepted. Corn responds well to phosphatic fertilizers in almost all the soil types. It plays vital role in plant nutrition. Enriched banana pseudostem sap which is used for foliar spray in experiment as a organic liquid is a rich source of plant nutrient like K, Fe and plant growth regulators and it is obtained as a by- product during extraction of fiber from banana plant which is first time prepared by soil and water management research unit NAU, Navsari.

Material and Methods
A field experiment was conducted at the College Farm, Navsari Agricultural University, Navsari during *rabi* season of 2017-18. The soil of experimental field was clay in texture, low in organic carbon (0.44%) and available nitrogen (190.30 kg/ha), medium in available P_2O_5 (32.15 kg/ha) and high in available K_2O (364.23 kg/ha). The soil was found slightly alkaline (pH 7.8) in nature with normal electric conductivity of 0.145 dS/m. The experiment was laid out in randomized block design with factorial concept (FRBD) with three replications. Total twelve treatment combinations consisting of three levels of fertilizer *viz*., 100% RDF (120:60:00 N:P:K kg/ha), 75% RDF (90:45:00 N:P:K kg/ha) and 50% RDF (60:30:00 N:P:K kg/ha), two dose of organic liquid *viz*., 1% organic liquid (D_1) and 2% organic liquid (D_2) and various time of spray of organic liquid *viz*., one spray of organic liquid at 40 DAS (T_1) and two spray of organic liquid at 30 DAS and 40 DAS (T_2). Maize variety "GM-3" was sown on 21 November 2017 using seed rate 25 kg/ha with raw spacing 60 cm and plant spacing 20 cm and crop was harvested on 14 marches 2018.

The field observation on plant height, dry matter accumulation/plant, number of leaves/plant, leaf area/plant, number of cobs/plant, number of grains/cob, cob length, cob girth, cob weight, test weight, grain and straw yield was recorded. Five plants from each plot were randomly selected and observations like plant height, dry matter accumulation/plant, number of leaves/plant, leaf area/plant at 30, 60, 90 DAS and at harvest were recorded and averaged. The yields attributed were recorded at harvesting to assess the contribution of yield. The experimental data analyzed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusion were drawn at 5% probability level. Economics of treatments also worked out.

Result and Discussion

Fertilizer application

Successive levels of fertilizer significantly increased the growth attributes, yield and yield attributes. Significantly higher plant height at 30, 60, 90 DAS and at harvest (71.15, 168.31, 182.48 and 197.81 cm, respectively), dry matter accumulation at 30, 60, 90 DAS and at harvest (7.28, 81.40, 163.57 and 187.78 g/plant, respectively), number of leaves/plant at 30 DAS (9.83), 60 DAS (11.10), 90 DAS (12.89) and at harvest (11.79) and leaf area/plant at 30 DAS (1476.6 cm^2), 60 DAS (2737.4 cm^2), 90 DAS (2938.9 cm^2) and at harvest (3188.3 cm^2), Number of cobs/plant (1.23) and grains/cob (445), Cob length (16.5 cm), cob girth (15.6 cm) Cob weight (159 g) and test weight (244.2 g), shelling% (78.00%) with higher grain yield (4507 kg/ha) and straw yield (8465 kg/ha) was recorded in treatment receiving 100% RDF, while the lowest in the 50% RDF but plant height, dry matter accumulation, number of leaves/plant, leaf area/plant, number of cobs/plant, grain yield, straw yield and shelling% remained at par with 75% RDF. The positive effect of nitrogen and phosphorus supplied through N and P fertilizers on growth could be as described to its effectiveness in providing a balanced nutritional both in rhizosphere and plant system. Nitrogen is considered to be a vitally important plant nutrient. It is an integral part of chlorophyll which is the primary absorber of light energy needed for photosynthesis. P is an important structural component of nucleic acid, protein, phospholipids and enzymes the overall improvement in crop growth and yield attributes as well as yield under the influence of nitrogen and phosphorus fertilization could possibly be better result of growth attributes, yield attributes and yield. The present investigation are in close conformity with the finding of Kumar *et al.* (2006) [5], Mathukia *et al.* (2014) [7] Damor *et al.* (2017) [2] and Sadhukhan *et al.* (2018) [9] in maize crop.

Dose of organic liquid

Appraisal of data shows that significantly the highest plant height at 60, 90 DAS and at harvest (166.42 cm, 180.42 cm and 193.79 cm, respectively) dry matter accumulation at 60, 90 DAS and at harvest (79.92 g, 161.31 g and 185.09 g, respectively), number of leaves/plant at 60, 90 DAS and at harvest (10.95, 12.60 and 11.64, respectively) and leaf area/plant at 60, 90 DAS and at harvest (2739.8 cm^2 , 2942.2 cm^2 and 3190.9 cm^2 , respectively) Number of cobs/plant (1.18) and grains/cob (444), cob length (15.7 cm), cob girth (14.5 cm) Cob weight (154 g) and test weight (236 g), shelling% (77.60%) with higher grain yield (4296 kg/ha) and straw yield (8436 kg/ha) was recorded in 2% organic liquid over 1% organic liquid. Foliar application of organic liquid to plant in the adequate amount to fulfill the nutrients requirement of maize crop which increased nutrients uptake that lead to improvement in the growth attributes which effectively increased the yield parameters of maize crop. Singhal *et al.* (2015) [11] in cow pea and Barad *et al.* (2017) [1] in pearlmillet.

Time of spray of organic liquid

Data given in Table 1, 2 and 3 shows that significantly the highest plant height at 60, 90 DAS and at harvest (165.87 cm, 181.50 cm and 194.56 cm, respectively) dry matter accumulation at 60, 90 DAS and at harvest (80.08 g, 162.86 g and 182.37 g, respectively), number of leaves/plant at 60, 90 DAS and at harvest (10.89, 12.58 and 11.66, respectively) and leaf area/plant at 60, 90 DAS and at harvest (2701.0 cm^2 , 2902.5 cm^2 and 3190.9 cm^2 , respectively) Number of cobs/plant (1.22) and grains/cob (443), cob length 16.3 cm), cob girth (14.9 cm) Cob weight (154 g) and test weight (239 g), shelling% (78.70%) with higher grain yield (4380 kg/ha) and straw yield (8448 kg/ha) was recorded in two spray of organic liquid at 30 DAS and 40 DAS (T_2) over one spray of organic liquid at 40 DAS (T_1). The increase in growth attributes may be due to spray of organic liquid at most critical growth stages satisfied the nutrients requirement of maize crop which enhanced the photosynthetic activity of plant resulted in higher production of photosynthesis leads better growth of crop. Dekhane *et al.* (2017) [3] in wheat.

Table 1: Effect of fertilizer application, dose of organic liquid and time of spray of organic liquid on plant height and dry matter accumulation/plant on maize.

Treatments	Plant height (cm)				Dry matter accumulation/plant (g)			
	At 30 DAS	At 60 DAS	At 90 DAS	At harvest	At 30 DAS	At 60 DAS	At 90 DAS	At harvest
(A) Fertilizer application (F)								
F_1-100% RDF	71.15	168.31	182.48	197.81	7.28	81.40	163.57	187.78
F_2-75% RDF	66.20	162.15	176.64	186.64	6.72	76.20	157.20	176.61
F_3-50% RDF	63.56	151.77	167.11	179.68	6.29	70.97	152.31	167.13
C.D. at 5%	4.67	11.60	12.26	14.07	0.42	5.79	8.07	12.36
(B) Dose of organic liquid (D)								
D_1-1% organic liquid	65.09	155.07	170.40	182.30	6.60	72.46	154.08	169.26
D_2-2% organic liquid	68.84	166.42	180.42	193.79	6.93	79.92	161.31	185.09
C.D. at 5%	NS	9.47	10.01	11.49	NS	4.72	6.59	10.09
(C) Time of spray of organic liquid (T)								
T_1-One spray at 40 DAS	66.08	155.62	169.32	181.53	6.75	72.30	152.53	171.97
T_2-Two spray at 30 DAS and 40 DAS	67.86	165.87	181.50	194.56	6.77	80.08	162.86	182.37
C.D. at 5%	NS	9.47	10.01	11.49	NS	4.73	6.56	10.09
Significant interaction	-	F × D × T	F × D × T	F × D × T	-	F × D × T	F × D × T	F × D × T

Table 2: Effect of fertilizer application, dose of organic liquid and time of spray of organic liquid on Number of leaves/plant and Leaf area/plant on maize

Treatments	Number of leaves/Plant				Leaf area/plant (cm^2)			
	At 30 DAS	At 60 DAS	At 90 DAS	At harvest	At 30 DAS	At 60 DAS	At 90 DAS	At harvest
(A) Fertilizer application (F)								
F_1-100% RDF	9.83	11.10	12.89	11.79	1476.6	2737.4	2938.9	3188.3
F_2-75% RDF	9.03	10.49	12.31	11.27	1364.6	2674.1	2875.7	3125.7
F_3-50% RDF	8.45	9.92	11.42	10.75	1284.4	2494.9	2663.4	2913.4
C.D. at 5%	0.74	0.91	0.90	0.58	103.42	160.57	180.81	181.21
(B) Dose of organic liquid (D)								
D_1-1% organic liquid	8.89	10.05	11.81	10.90	1345.7	2531.1	2710.7	2960.7
D_2-2% organic liquid	9.31	10.95	12.60	11.64	1404.7	2739.8	2941.2	3190.9
C.D. at 5%	NS	0.73	0.74	0.47	NS	131.10	147.60	148.0
(C) Time of spray of organic liquid (T)								
T_1-One spray at 40 DAS	8.95	10.11	11.84	10.88	1353.3	2569.9	2749.4	2960.7
T_2-Two spray at 30 DAS and 40 DAS	9.26	10.89	12.58	11.66	1397.1	2701.0	2902.5	3190.9
C.D. at 5%	NS	0.73	0.74	0.47	NS	131.10	147.63	147.96
Significant Interaction	-	-	-	F × D × T	-	F × D × T	F × D × T	F × D × T

Table 3: Effect of fertilizer application, dose of organic liquid and time of spray of organic liquid on yield attributes and yields of maize.

Treatments	Number of cobs/plant	Number of grains/cob	Cob length (cm)	Cob girth (cm)	Cob weight (g)	Test weight (g)	Shelling%	Grain yield (kg/ha)	Straw yield (kg/ha)
(A) Fertilizer application (F)									
F_1-100% RDF	1.23	445	16.5	15.6	159	244.2	78.0	4507	8465
F_2-75% RDF	1.11	440	15.6	14.7	148	223.8	74.0	4285	8354
F_3-50% RDF	1.05	409	13.8	12.0	142	198.6	70.0	3785	7799
C.D. at 5%	0.13	27.0	0.8	0.9	8.3	17.8	6.3	253.3	562.4
(B) Dose of organic liquid (D)									
D_1-1% organic liquid	1.07	419	14.9	13.6	146	208.4	70.4	4089	7976
D_2-2% organic liquid	1.18	444	15.7	14.5	154	236	77.6	4296	8436
C.D. at 5%	0.11	22.1	0.7	0.7	6.79	14.56	5.2	206.8	459.2
(C) Time of spray of organic liquid (T)									
T_1-One spray at 40 DAS	1.03	420	14.3	13.3	146	205	69.3	4005	7964
T_2-Two spray at 30 DAS and 40 DAS	1.22	443	16.3	14.9	154	239	78.7	4380	8448
C.D. at 5%	0.11	22.1	0.68	0.23	6.79	14.56	5.2	206.8	459.2
Significant Interaction	-	F × D × T	-	-	F × D × T	F × D × T	-	F × D × T	-

Interaction effect

Significantly higher plant height of *rabi* maize at 60 DAS (185.44 cm, 90 DAS (199.49 cm) and at harvest (219.80 cm) were found under treatment combination of $F_1D_2T_2$ but, it remained at par with treatment combination of $F_1D_1T_1$, $F_1D_1T_2$, $F_2D_2T_2$, $F_3D_1T_2$ for plant height at 60 DAS, $F_2D_2T_2$, $F_1D_1T_2$, $F_3D_2T_1$, $F_1D_1T_1$, $F_2D_1T_2$ for plant height at 90 DAS and $F_2D_2T_2$, $F_1D_1T_1$, $F_1D_1T_2$ for plant height at harvest. Significantly higher dry matter accumulation/plant of maize at 60 DAS (91.13 g), 90 DAS (180.30 g) and at harvest (211.91 g) were found under treatment combination of $F_1D_2T_2$ and it remained at par with treatment combination of $F_2D_2T_2$. Number of leaves/plant of maize at harvest (12.76) was found significantly higher under treatment combination of $F_1D_2T_2$ and it remained at par with treatment combination of $F_2D_2T_2$. Significantly higher leaf area/plant of *rabi* maize at 60 DAS (2980.37 cm^2), 90 DAS (3181.9 cm^2) and at harvest (3431.9 cm^2) were found under treatment combination of $F_2D_2T_2$ but it remained at par with treatment combinations of $F_1D_2T_1$, $F_1D_1T_2$, $F_2D_2T_1$. Number of grains/cob was noted significantly higher under treatment combination of $F_1D_2T_2$ which remained statistically at par with treatment combination of $F_2D_2T_2$, $F_2D_2T_1$, $F_1D_1T_1$, and $F_2D_1T_2$. Significantly higher cob weight of maize was recorded under treatment combination of $F_1D_2T_2$ and it remained at par with treatment combination of $F_1D_1T_1$. Test weight (1000 seed weight) of *rabi* maize was noted significantly higher under treatment combination of $F_1D_2T_2$. Grain yield (4939 kg/ha) of *rabi* maize was noted significantly higher under treatment combination of $F_1D_2T_2$ which remained statistically at par with treatment combination of $F_2D_2T_2$ over other treatment combinations. The increases in growth attributes like plant height, dry matter accumulation/plant, number of leaves/plant and leaf area/plant may be due to supply of essential plant nutrients at right time in right proportion through inorganic and organic forms of fertilizer by soil application as well as foliar application under these treatment combinations which resulted in higher production of photosynthates which utilizes by plant for development of sink of maize plant so better growth and yield parameters found under these treatment combinations which ultimately resulted in higher grain yield. These findings are in close vicinity with those reported by Loganathan and Wahab (2014) [6] in baby corn, Devi and Mani (2015) [4] in rice, Pal *et al.* (2015) [8] in sweet corn, Sahare (2015) [10] in rice crop and Dekhane *et al.* (2017) [3] in wheat.

Economics

Data presented in Table 6 revealed that higher net realization of ₹ 85205/ha obtained with treatment combination of $F_1D_2T_2$ followed by treatment combination of $F_2D_2T_2$ and $F_2D_1T_2$ which secured ₹ 80505 and ₹ 74484/ha net return, respectively. However, the lowest net returns (₹ 50657/ha) was noted with treatment combination of $F_3D_1T_1$. The highest BCR (3.38) were obtained with treatment combination $F_1D_2T_2$ followed by $F_2D_2T_2$ and $F_2D_1T_2$ and were secured 3.30 and 3.17 BCR, respectively.

However, the lowest BCR 2.56 was noted with treatment combination of $F_3D_1T_1$. It might be due to higher yield found in this treatment combinations *i.e* $F_1D_2T_2$ and $F_2D_2T_2$.These findings are in close conformity with those reported by Pal *et al.* (2015) [8] in maize.

Table 4: Interaction effect of various treatments on growth attributes of maize

Treatment		Plant height (cm) at 60 DAS		Plant height (cm) at 90 DAS		Plant height (cm) at harvest		Dry matter accumulation/plant (g) at 60 DAS		Dry matter accumulation/plant (g) at 90 DAS		Dry matter accumulation/plant (g) at harvest	
F	D	T		T		T		T		T		T	
		T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2	179.94	180.22
F_1	D_1	163.09	163.07	176.62	178.95	196.90	194.36	76.80	78.33	158.97	160.50	179.03	211.91
	D_2	161.66	185.44	174.85	199.49	180.19	219.80	79.33	91.13	154.50	180.30	164.41	170.70
F_2	D_1	152.18	159.25	166.13	175.32	174.60	182.97	67.57	74.80	149.74	156.97	178.19	193.15
	D_2	155.26	181.90	168.88	196.28	186.51	202.48	73.27	89.17	154.10	168.00	148.34	171.95
F_3	D_1	136.38	156.45	151.97	173.41	160.96	184.01	62.07	75.20	140.90	157.37	181.94	166.31
	D_2	165.15	149.09	177.49	165.57	190.00	183.75	74.77	71.86	156.94	154.03	179.94	180.22
S.Em. ±		7.91		8.36		9.59		3.95		5.51		8.42	
C.D. 5%		23.21		24.53		28.14		11.58		16.15		24.72	

Table 5: Interaction effect of various treatments on growth attributes, yield attributes and yield of maize

Treatment		Number of leaves/plant at harvest		Leaf area/plant (cm^2) at 60 DAS		Leaf area/plant (cm^2) at 90 DAS		Leaf area/plant (cm^2) at harvest		Number of grains/cob		Cob weight (g)		Test weight (g)		Grain yield (kg/ha)	
F	D	T		T		T		T		T		T		T		T	
		T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
F_1	D_1	11.33	11.48	2532.8	2784.3	2734.3	2985.8	2984.3	3235.8	440.99	424.01	158	153	217.0	228.3	4365	4379
	D_2	11.58	12.76	2785.3	2847.1	2986.8	3048.6	3236.8	3296.3	429.51	485.97	154	173	225.9	305.5	4346	4939
F_2	D_1	10.41	11.13	2589.8	2447.3	2791.3	2648.8	3041.3	2898.8	409.46	435.76	142	151	179.9	237.1	3997	4340
	D_2	10.98	12.57	2679.3	2980.4	2880.8	3181.9	3130.8	3431.9	454.53	459.43	149	154	219.3	258.9	4290	4697
F_3	D_1	9.86	11.17	2257.7	2575.2	2327.1	2776.7	2577.1	3026.7	369.39	432.84	128	146	189.5	198.3	3272	4178
	D_2	11.13	10.84	2574.8	2571.9	2776.3	2773.4	3026.3	3023.4	418.34	416.77	146	148	198.7	207.6	3759	3929
S.Em. ±		0.39		109.49		123.29		123.57		18.44		5.6		12.2		172.7	
C.D. 5%		1.16		321.14		361.62		362.43		54.07		16.6		35.7		506.7	

Table 6: Effect of various treatment combinations on economics of maize

Treatments	Yield (kg/ha)		Cost of production (₹/ha)	Gross realization (₹/ha)	Net realization (₹/ha)	B:CRatio
	Seed	Straw				
$F_1D_1T_1$	4365	8119	34304	107606	73302	3.14
$F_1D_1T_2$	4378	8289	35194	108297	73103	3.07
$F_1D_2T_1$	4346	8542	34954	108284	73330	3.10
$F_1D_2T_2$	4939	8906	35844	121050	85205	3.38
$F_2D_1T_1$	3997	7671	33404	99135	65731	2.97
$F_2D_1T_2$	4340	8789	34294	108778	74484	3.17
$F_2D_2T_1$	4289	8348	34054	106663	72609	3.13
$F_2D_2T_2$	4697	8603	34944	115449	80505	3.30
$F_3D_1T_1$	3271	7091	32508	83165	50657	2.56
$F_3D_1T_2$	4177	7892	33398	103288	69890	3.10
$F_3D_2T_1$	3759	8007	33158	95202	62044	2.87
$F_3D_2T_2$	3929	8204	34048	99096	65048	2.91

Conclusion

On the basis of results obtained in the present investigation, it can be concluded that *rabi* maize var. GM-3 should be fertilized with 75% RDF (90-45-00 NPK Kg/ha) along with foliar spray of 2% organic liquid (Enriched banana pseudostem sap) at 30 and 40 DAS under south Gujarat condition for obtaining more remunerative production with sustaining soil nutrients status.

References

1. Barad HL, Patel CK, Patel DK, Sharma S, Joshi JR. Effect of organic manures and levels of inorganic fertilizers with and without banana sap on yield, quality and economics of summer pearlmillet (*Pennisetum glaucum* L.) under south Gujarat condition. International Journal of Science, Environment and Technology. 2017;6(4):2224-2231.
2. Damor N, Patel GN, Patel NI, Patel CK, Vagela S. Response of rabi maize (*Zea mays* L.) to different dates of sowing and fertility levels. International Journal of Science, Environment and Technology. 2017;6(3):1905-1911.
3. Dekhane SS, Mangave BD, Dumbre RB, Patel DJ. Effect of organic products on plant growth and yield of Wheat. International Journal of Horticulture, Agriculture and Food Science. 2017;1(4):2456-8635.
4. Devi LN, Mani S. Effect of Seaweed Saps kappaphycus alvarezii and gracilaria on growth, yield and quality of rice. Indian Journal of Science and Technology. 2015;8(19):47610.
5. Kumar A, Chillar RK, Gautam RC. Nutrient requirement of winter maize (*Zea mays* L.) based intercropping systems. Indian Journal of Agricultural Science. 2006;76(5):315-318.

6. Loganathan V, Wahab K. Influence of Panchagavya foliar spray on the growth attributes and yield of baby corn (Zea mays L.) cv. COBC 1. Journal of Applied and Natural Science. 2014;6(2):397-401.
7. Mathukia RK, Choudhary RP, Shivran A, Bhosale N. Response of rabi sweet corn to plant geometry and fertilizer. Current Biotica. 2014;7(4):294-298.
8. Pal A, Dwivedi SK, Maurya PK, Kanwar P. Effect of seaweed saps on growth, yield, nutrient uptake and economic of maize (sweet corn). Journal of Applied and Natural Science. 2015;7(2):970-975.
9. Sadhukhan R, Bohra JS, Choudhury S. Effect of fertility levels and cow urine foliar spray on growth and yield of wheat. International Journal of Current Microbiology and Applied Science. 2018;7(3):907-912.
10. Sahare D. Impact of organic manures and liquid organic manures on growth, yield and quality of aerobic rice. The Ecoscan. 2015;9(1):563-567.
11. Singhal V, Patel GG, Patel DH, Kumar U, Saini L. Effect of foliar application of water-soluble fertilizers on growth, yield and economics of vegetable cowpea production. The Ecoscan. 2015;7:79-83.