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Effect of Foliar Sprays of Nutrients on Growth, Yield and Quality of Silage Maize (*Zea mays* L.) Production

Avachar R.P.*, Ugale N.S., Danawale N.J., Takate A.S. and Chandane V.S.
Department of Agronomy,
Mahatma Phule Krishi Vidyapeeth, MPKV, Rahuri (Maharashtra), India.

(Corresponding author: Avachar R.P.)*
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ABSTRACT : A field experiment entitled "Effect of foliar sprays of nutrients on growth, yield and quality of silage maize (*Zea mays* L.) production" was undertaken during *rabi* season of the 2021 at AICRP on Integrated Farming Systems Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri to assess the Influence of nutrients on growth and yield and quality characters of fodder maize and silage in *kharif* season. The experiment was laid out in Randomized Block Design with three replications. There were ten treatments used during the course of the experiment and they are comprised of T_1 : (Absolute control), T_2 : GRDF (100:50:50 N : P_2O_5 : K_2O kg ha^{-1} + FYM 5 t ha^{-1}), T_3 : Two foliar sprays of water, T_4 : Two foliar sprays of 19:19:19 @ 1%, T_5 :Two foliar sprays of 12:61:00 @ 1%, T_6 : Two foliar sprays of 13:00:45 @ 1%, T_7 : Two foliar sprays of 00:52:34 @ 1% , T_8 : Two foliar sprays of Phule Liquid Micro grade II @ 1% , T_9 : Two foliar sprays of chelated Zn-EDTA @ 0.20 %, T_{10} : Two foliar sprays of chelated Fe-EDTA @ 0.20 % @ 15 and 30 DAS, respectively. The treatment T_8 *i.e.*, Two foliar sprays of Phule Liquid Micro grade II @ 1% recorded significantly higher value of green fodder yield (50.92 t ha^{-1}) and silage yield (48.37 t ha^{-1}) followed by treatment T_4 *i.e.*, Two foliar sprays of 19:19:19 @ 1% having green fodder yield (49.85 t ha^{-1}) and silage yield (47.35 t ha^{-1}).The treatment T_8 *i.e.*, Two foliar sprays of Phule Liquid Micro grade II @ 1% recorded higher gross monetary returns (338590 ₹ ha^{-1}), net monetary returns (190160 ₹ ha^{-1}) and B:C ratio (2.28) followed by treatment T_4 *i.e.*, Two foliar sprays of 19:19:19 @ 1%. The lowest gross monetary returns (184170 ₹ ha^{-1}), net monetary returns (87972 ₹ ha^{-1}) and B:C ratio (1.91) were recorded in treatment T_1 *i.e.*, Absolute control. On the basis of one season trial data, it could be concluded that foliar sprays of Phule liquid micrograde-II @ 1% at 30 and 45 days after sowing found beneficial yield contributing characters, yield of green forage and silage and monetary returns of silage.

Keywords: Silage, fodder, foliar spray, nutrients, Phule Micrograde-II.

INTRODUCTION

Agriculture is the key sector of the Indian economy and allied sector contributes nearly 18.8 % of GDP (Anonymous a-2022-2023) and about around 58 % of the population dependent on agriculture and allied sectors such as livestock, poultry and fishery etc. for their livelihood. Cereals are grass like crop plants in the Poaceae family that are produced for their edible starchy seeds that have a global impact. About half of the world's ploughed land is used to cultivate the major grains. Wheat, rice, corn, barley, oat, rye, sorghum, and millets account for 56 % of global food energy and 50 % of global protein consumption. In general, wheat, rice, and corn account for three-quarters of global grain production. Sorghum, barley, millets, rye, and oats account for the world's remaining cereal grain production.

Considering the national scenario in India, maize is cultivated on 9.03 million hectares and its total production is 27.72 million tones. Where as in Maharashtra, area under maize is 0.92 million hectares and its production is 3.71 million tones. Maharashtra ranked third in area (10.18 %) and sixth in production (13.38 %). The national productivity of maize is 3070 kg ha^{-1} while, in Maharashtra it is 1905.5 kg ha^{-1} (Anonymous 2022-23).

Maize is also used as fodder crop for livestock. Fodder includes green fodder and dry fodder, in dry fodder includes hay, straws etc. Silage is one of the form of preserved forage which is highly palatable and contain more nutrients than dry fodder. African tall is one of variety of maize which is suitable for silage making. Silage is pasture grass that has been pickled. It is a method used to preserve the pasture for cows and sheep to eat latter when natural pasture is not good like in dry season. The grasses are cut and then fermented to keep as much of the nutrients (such as sugar and proteins) as possible.

Foliar nutrition is particularly successful since leaves absorb nutrients much faster than roots. The use of a balanced fertilizer throughout the important growth phases will considerably improve the quantity and quality of agricultural output. When fertilizers are

applied foliar, the plant uses more than 90 % of the fertilizer, however when the same amount is applied to the soil, only 10 % of the fertilizer is used. Foliar application of nutrients in combination with soil application has various advantages in supplementing crop nutritional requirements, including faster and more efficient plant response, less quantity of fertilizer required, maintaining soil health and overcoming the problems of nutrient fixation and immobilization.

In India, livestock plays an important role for the nutritional security, particularly of the small and marginal farmers. Animals provide nutrient-rich products, draught power, dung as organic manure and domestic fuel, hide and skin are regular source of cash income for rural households. According to 20th livestock census 2019, India's livestock population is 535.78 million out of which 192.49 million cattle, 109.85 million buffaloes, 148.88 million goats, 74.26 million sheep populations. Livestock shows 1% growth rate over previous census, cattle shows 0.8% growth rate, buffalo has 1% growth rate while goat and sheep has 10.1% and 14.1% growth rate respectively. In world India ranks first in livestock population, ranks second in cattle and goat population, first in buffalo population while third in sheep population (Anonymous b- 2020).

Silage making is long age practiced by the larger agricultural sector but the production method relies on heavy equipment and large production, in order to dig or build storage pits and to compress the green mass, putting it beyond the reach of small holder farmers. However, due to technological advancement in packaging industry, now a days silage bags has been developed and shown to be a workable system for small holding farmers. Strong plastic shopping bags and plastic lined fertilizers bags are available in most of rural areas; these can be used to make very good silos. There are many advantages of bag silage to the small holders. A key feature of silage bags is that it allows conservation of available fodder in small quantities over a long period of time. It is generally much easier to feed silage from individual bags instead of having to untie and retie the large bags of thick plastic or use silage from larger permanent silos (Alemu, 2008).

MATERIAL AND METHODS

A field experiment entitled "Effect of foliar sprays of nutrients on growth, yield and quality of silage maize (*Zea mays* L.) production" was conducted at the AICRP on Integrated Farming Systems Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri and Dist. Ahmednagar during *Kharif* season of 2022-23. Geographically, the AICRP on Integrated Farming Systems Farm of M.P.K.V., Rahuri lies on the elevation of 495 to 569 m above sea level. It is situated between 190 48' and 190 57' North latitude and 740 10' and 740 32' East longitude. The soil in the experimental field belongs to Inceptisole order having a depth more than 60 cm and the topography is uniform and levelled. For the assessment of initial soil fertility status, representative initial soil samples were taken. These soil samples were properly mixed and a composite soil sample was created and evaluated for physical and chemical soil parameters. The soil texture of experimental field was clay loam, medium in available nitrogen (234.06 kg ha^{-1}), medium in available phosphorus (24.95 kg ha^{-1}) and very high in available potassium (336 kg ha^{-1}). In reaction, the soil in the experimental field was mildly alkaline (pH 7.58) with 0.31 per cent organic carbon, soil electrical conductivity was 0.71 dSm^{-1}. Agro-climatically, this area is located in rain scarcity zone of Maharashtra (drought prone area). Monsoon season usually begins in the third week of June and ends in the last week of September, with yearly rainfall ranging from 307 to 619 mm, with an average rainfall of 520 mm. This is entirely through South-West monsoon. The rainfall is mostly received in 15 to 45 rainy days in year. The experiment was laid out in Randomized Block Design with three replications. There were ten treatments used during the course of the experiment and they are comprised of T_1 : (Absolute control), T_2 : GRDF (100:50:50 N : P_2O_5 : K_2O kg ha^{-1} + FYM 5 t ha^{-1}), T_3 : Two foliar sprays of water , T_4 : Two foliar sprays of 19:19:19 @ 1%, T_5 :Two foliar sprays of 12:61:00 @ 1% , T_6 : Two foliar sprays of 13:00:45 @ 1%, T_7 : Two foliar sprays of 00:52:34 @ 1% , T_8 : Two foliar sprays of Phule Liquid Micro grade II @ 1% , T_9 : Two foliar sprays of chelated Zn-EDTA @ 0.20 %, T_{10} : Two foliar sprays of chelated Fe-EDTA @ 0.20 % 15 and 30 DAS, respectively. Foliar application of nutrients is at 30 and 45 days after sowing. The seeds of fodder maize (African tall) were obtained from Krushiseva Kendra, Rahuri. Sowing was done on 7th July 2022 by dibbling two seeds at each hill at recommended spacing 30 cm × 20 cm. Harvesting was done manually at milk stage of crop *i.e.,* 76 days after sowing for silage making.

RESULTS AND DISCUSSION

A. Yield characters

(i) Green forage yield. Data in respect of green forage yield at harvest of forage maize as influenced by different foliar nutrient management treatment are presented in Table 1. The mean green forage yield was 45.57 t ha^{-1}.

It is quite clear from the data presented in Table 1 that the different foliar nutrient management treatment had significant influence on green forage yield. The application of Two foliar sprays of Phule liquid micrograde II @ 1 % (T_8) shows significantly higher green forage yield (50.92 tha^{-1}). Whereas, significantly lowest green forage yield (27.96 t ha^{-1}) was noticed under absolute control.

Among the different treatments, application of 1% foliar spray of Phule liquid micrograde- II along with GRDF recorded significantly higher green fodder yield as compared to other treatments. This may be mainly attributed to improved growth parameters *viz.*, plant height, number of functional leaves, dry matter accumulation, leaf area, leaf area index, various growth indices and the beneficial effects of micronutrients on cell division and elongation, formation of nucleotides and co-enzymes which resulted in increased meristematic activity and photosynthetic area and hence

more production and accumulation of photosynthates yielding higher green fodder. The findings of Bhilare *et al*. (2002); Pathan *et al*. (2006); Sheoran *et al*. (2008); Bhoya *et al*. (2013); Choudhary and Prabhu (2014) confirmed the results

(ii) Silage yield. Data in respect of silage yield of forage maize as influenced by different foliar nutrient management treatment are presented in Table 1. The mean green forage yield was 43.27 t ha^{-1}.

It is quite clear from the data presented in Table 1 that the different foliar nutrient management treatment had significant influence on green forage yield which automatically results in the increase of silage yield. The application of Two foliar sprays of Phule liquid micrograde II @ 1 % (T_8) shows significantly higher silage yield (48.37 t ha^{-1}). Whereas, significantly lowest silage yield (26.31 t ha^{-1}) was noticed under absolute control. The findings of Sheoran *et al*. (2008); Bhoya *et al*. (2013); Choudhary and Prabhu (2014) confirmed the results.

Table 1: Green forage yield of fodder maize and Silage yield influenced by different treatments.

Tr. No.	Treatment	Green forage yield (t ha^{-1})	Silage yield (t ha^{-1})
T_1	Absolute Control	27.96	26.31
T_2	GRDF (100:50:50 kg ha^{-1} $N:P_2O_5:K_2O$ + FYM 5 t ha^{-1})	44.11	41.90
T_3	Two foliar sprays of water	44.55	42.32
T_4	Two foliar sprays of 19:19:19 @ 1 %	49.85	47.35
T_5	Two foliar sprays of 12:61:00 @ 1 %	48.70	46.25
T_6	Two foliar sprays of 13:00:45 @ 1 %	48.76	46.32
T_7	Two foliar sprays of 00:52:34 @ 1 %	47.62	45.23
T_8	Two foliar sprays of Phule liquid micrograde II @ 1%	50.92	48.37
T_9	Two foliar sprays of Chelated Zn EDTA @ 0.20 %	46.75	44.41
T_{10}	Two foliar sprays of Chelated Fe EDTA @ 0.20 %	46.50	44.32
S.Em. ±		0.35	0.33
C.D. at 5%		1.05	1.01
General mean		45.57	43.27

B. Economics

The gross monetary returns, net monetary returns and benefit : cost ratio of fodder maize was significant influenced by different foliar sprays treatments are presented in Table 2. The mean gross monetary return, cost of cultivation and net monetary return were ₹ 302946, ₹ 136908 and ₹ 166037 ha^{-1} respectively. The mean benefit : cost ratio was 2.20.

(i) Gross monetary returns. The data in respect to gross monetary returns was presented in table revealed that the application of Two foliar sprays of Phule liquid micrograde II @ 1% (T_8) recorded significant highest gross monetary return (₹ 338590 ha^{-1}) which is at par with the application of two foliar sprays of 19:19:19 (T_4) having gross monetary returns (₹ 331450 ha^{-1}). The increase in gross monetary return in treatment T_8 due to the highest green forage yield and silage yield as compared to other treatments. These findings are consistent with those of Ashoka *et al*. (2008); Tetarwal *et al.* (2009).

(ii) Cost of cultivation. The mean value of cost of cultivation was found to be ₹ 136908 ha^{-1} in case of silage made up from fodder maize. foliar application slightly increases the cost of cultivation. The maximum cost of cultivation was recorded in the treatment allocated with application Two foliar sprays of Phule liquid micrograde II @ 1% *i.e.,* (T_8) is (₹ 148430 ha^{-1}). The lowest cost of cultivation was recorded in absolute control during the period of investigation.

(iii) Net monetary returns. The data in respect to net monetary returns was statistically analyzed and presented in table revealed that the application of Two foliar sprays of Phule liquid micrograde II @ 1% (T_8) recorded significant highest net monetary return (₹ 190160 ha^{-1}) which is at par with the application of two foliar sprays of 19:19:19 (T_4) having net monetary returns (₹ 186139 ha^{-1}). The treatment T_8 recorded significantly highest net monetary return might be due to highest green forage yield as well as the silage yield. These findings are consistent with those of Ashoka *et al*. (2008); Tetarwal *et al.* (2009).

(iv) B:C ratio. The data regarding benefit : cost ratio presented in table revealed that the application of two foliar sprays of Phule liquid micrograde II @ 1% (T_8) recorded highest benefit : cost ratio (2.28). It was same in the treatment T_4 (Two foliar sprays of 19:19:19 @ 1 %) highest B : C ratio observed in treatment T_8, it might be due to highest gross monetary return of that treatment as compared to rest of all treatments under studies. These findings are in conformity with Ashoka *et al*. (2008); Tetarwal *et al.* (2009).

Table 2: Cost of cultivation, gross monetary returns, net monetary returns and B:C ratio of fodder maize and silage as influenced by different foliar spraying.

Tr. No.	Treatment	Cost of cultivation (₹ ha^{-1})	Gross Monetary Returns (₹ ha^{-1})	Net Monetary Returns (₹ ha^{-1})	B:C Ratio
T_1	Absolute Control	96198	184170	87972	1.91
T_2	GRDF (100:50:50 kg ha^{-1} $N:P_2O_5:K_2O$ + FYM 5 t ha^{-1})	134253	293300	159047	2.18
T_3	Two foliar sprays of water	135701	296240	160539	2.18
T_4	Two foliar sprays of 19:19:19 @ 1 %	145311	331450	186139	2.28
T_5	Two foliar sprays of 12:61:00 @ 1 %	144006	323750	179744	2.24
T_6	Two foliar sprays of 13:00:45 @ 1 %	144008	324240	180232	2.25
T_7	Two foliar sprays of 00:52:34 @ 1 %	141920	316610	174690	2.23
T_8	Two foliar sprays of Phule liquid micrograde II @ 1 %	148430	338590	190160	2.28
T_9	Two foliar sprays of Chelated Zn EDTA @ 0.20 %	139821	310870	171049	2.22
T_{10}	Two foliar sprays of Chelated Fe EDTA @ 0.20 %	139436	310240	170804	2.22
S.Em. ±		-	2394	1373	-
C.D. at 5%		-	7180	4117	-
General mean		136908	302946	166037	2.20

CONCLUSIONS

Among all the treatments, the two foliar sprays of Phule Liquid Micrograde II @ 1% found superior in terms of yield of fodder and silage. The cost of cultivation was low in absolute control followed by GRDF (100:50:50 kg ha^{-1} N: P_2O_5: K_2O + FYM 5 t ha^{-1} but the maximum net monetary return (1,90,160 ₹ ha^{-1}) and B : C ratio (2.28) was observed in two foliar sprays of Phule Liquid Micrograde II @ 1%.

On the basis of one season trial data, it could be concluded that foliar sprays of Phule liquid micrograde-II @ 1% or water soluble fertilizer 19:19:19 @ 1% at 30 and 45 days after sowing found beneficial in yield contributing characters, yield of green forage and silage and monetary returns of silage.

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