Original Research Article……….

International Journal of Agricultural Invention

(online available at www.agriinventionjournal.com)

International Journal of Agricultural Invention 9(2): 22-26: December, 2024

ISSN: 2456 – 1797 (P)

Effect of splitting nitrogen and harvesting time on yield and economics of fodder Maize (*Zea mays* L.)

***P. S. Gotsurya, P. R. Patil, S. S. Ilhe, G. B. Shendage, P. A. Shitole, K. S. Pathade, P. V. Sawant**

Dr. Sharadchandra Pawar College of Agriculture, Baramati, Pune, Maharashtra, India

***Corresponding email**: *prathameshgotsurya2504@gmail.com*

ARTICLE INFO

Original Research Article

Received on August 19, 2024

Revised on September 12, 2024

Accepted on September 19, 2024

Published on October 27, 2024

Article Authors

P. S. Gotsurya, P. R. Patil, S. S. Ilhe, G. B. Shendage, P. A. Shitole, K. S. Pathade, P. V. Sawant

Corresponding Author Email

prathameshgotsurya2504@gmail.com

PUBLICATION INFO

International Journal of Agricultural Invention (IJAI)

RNI: UPENG/2016/70091

ISSN: 2456-1797 (P)

Vol.: 9, **Issue:** 2, **Pages:** 22-26

Journal Homepage URL

http://agriinventionjournal.com/

DOI: 10.46492/IJAI/2024.9.2.5

ABSTRACT

The field experiment entitled "Effect of splitting of nitrogen and harvesting time on yield and economics of fodder maize (*Zea mays* L.)" was conducted during the *kharif* season of 2023-24 at Dr. Sharadchandra Pawar College of Agriculture, Baramati. The field research was laid out in factorial randomized block design (FRBD) with three replications. There were nine treatment combinations consisting of three nitrogen splitting treatments *i.e.*, N_1: 50 % RDN at (basal) + 50 % RDN at 30 DAS, N_2: 75 % RDN at (basal) + 12.5 % RDN at 15 DAS and 12.5 RDN at 30 DAS, N_3: 50 % RDN at (basal) + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS and three harvesting times *i.e.*, C_1: Harvesting at flowering stage, C_2: Harvesting at milk stage, C_3: Harvesting at physiological maturity stage. Among different nitrogen splitting, applications of 50 % RDN at (basal) + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS recorded significantly higher yield parameters and economics studies such as green fodder yield (581.96 q ha^{-1}), dry matter content (21.61%) dry matter yield (126 q ha^{-1}), gross monetary returns (₹ 192045 ha^{-1}), net monetary returns (₹ 117740 ha^{-1}) and B: C ratio (2.58) than other treatments. Whereas, harvesting time of fodder maize harvesting at physiological maturity obtained significantly higher yield parameters and economics studies *viz.*, green fodder yield (580.58 q ha^{-1}), dry matter content (21.79%), dry matter yield (126.95 q ha^{-1}), gross monetary returns (₹ 191591 ha^{-1}), net monetary returns (₹ 113787 ha^{-1}) and B: C ratio (2.47) as compared to other remaining harvesting stages.

KEYWORDS

Harvesting Time, Splitting Nitrogen, Green Fodder Yield, Dry Matter Content, Dry Matter Yield, Gross Monetary Returns, Net Monetary Returns, B: C Ratio

HOW TO CITE THIS ARTICLE

Gotsurya, P. S., Patil, P. R., Ilhe, S. S., Shendage, G. B., Shitole, P. A., Pathade, K. S., Sawant, P. V. (2024) Effect of splitting nitrogen and harvesting time on yield and economics of fodder Maize (*Zea mays* L.), *International Journal of Agricultural Invention*, 9(2): 22-26. DOI: 10.46492/IJAI/2024.9.2.5

Maize (*Zea mays* L.) is known as the "Queen of Cereals" or "Miracle Crop" due to having significant highest genetic yield potential. Maize is a crop that grows quickly, produces a lot and provides beneficial nutrients (Arya *et al.*, 2020). It is a significant summer and *Kharif* fodder crop that is farmed throughout the nation and gives cattle incredibly tasty, succulent and nutrient-rich fodder. While maize fodder is typically ensiled in cooler climates, year-round maize production in the tropics may allow for the continuous harvesting of green fodder.

This is especially true when it comes to green forage that contains the leaves, ears and stalks which are an energy-rich source of feed for ruminant livestock (Brewbaker, 2003). It is a crucial source of nutrient-rich fodder for smallholder-owned livestock in environments with inhospitable conditions and limited pasture (Methu *et al.*, 2006). Maize has rapid growth, increased yield potential, palatability and richness in necessary nutrients and the ability to influence cattle growth and milk quality (Sattar *et al.*, 1994).

The protoplasmic content is increased by nitrogen, which also causes a rise in cell size, leaf area and photosynthetic activity. It is the primary cause of the creation of dry matter (DM) (Porte *et al*., 2023). Increases in crop growth rate, leaf area index, net absorption rate, plant height, number of leaves plant^{-1} and stem diameter were the main causes of the rise in fodder yield (Ram and Singh, 2003). Nutrient use efficiency can be increased by growers dividing the total nitrogen application into two or more splits. Splitting nitrogen not only improves the efficiency of nitrogen application but also reduces leaching and volatilization losses (Verma *et al*., 2023). Reducing nutrient losses through different fertilizer applications and nitrogen splitting, more nutrients may become accessible for crop plants to absorb effectively, potentially leading to a nutrient economy (Mandal and Thakor, 2010). Supply of nutrients at an appropriate time and amount is always essential for better growth and development of a fodder crop (Witt *et al*., 2008).

Harvesting time plays a very significant role in affecting yield and the quality of fodder (Hassan *et al*., 2016). The primary determinant of feed quality at harvest is the maturity stage and as maturity advances, feed quality declines (Ball *et al*., 2001). To boost the yield of fodder crops, cutting management is a crucial activity. The intervals between cuttings for different fodder crops vary (Pathan *et al*., 2013). Harvest is a critical time because as a plant matures, its structural elements and the ratio of stems to leaves rise but its CP content decreases (Wadi *et al*., 2004). Thus, quality and quantity of fodder maize yield depends on nitrogen splitting and harvesting time. So experiment was conducted to evaluate their effect on performance of fodder maize.

Materials and Methods

A field experiment entitled "Effect of splitting of nitrogen and harvesting time on yield and economics of fodder maize (*Zea Mays* L.)" was carried out during July 2023 to October 2023 *Kharif* season at the Dr. Sharadchandra Pawar College of Agriculture, Baramati. The soil texture of the experimental field was clay, low in available nitrogen (190.45 kg ha^{-1}), medium in available phosphorus (27.98 kg ha^{-1}) and very high in available potassium (508.12 kg ha^{-1}).

The soil of the experimental field was moderately alkaline in reaction (pH 7.4). The electrical conductivity of the soil was 0.32 dS m^{-1} with 0.79 percent organic carbon. The field experiment was laid out in a factorial randomized block design (FRBD) by two factors and three replications. It includes nine treatment combinations with three treatments of apportioning of nitrogen *i.e*., N_1: (50 % RDN at (basal) + 50 % RDN at 30 DAS), N_2: (75 % RDN at (basal) + 12.5 % RDN at 15 DAS and 12.5 % RDN at 30 DAS) and N_3: (50 % RDN at (basal) + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS) as well as three treatments of harvesting time *viz*.:

C_1: Harvesting at flowering stage
C_2: Harvesting at milk stage
C_3: Harvesting at physiological maturity stage.

The gross plot and net plot size were 4 m × 3 m and 3.6 m × 2.4 m, respectively. The spacing for sowing was 30 cm × 5 cm of fodder maize. The fodder maize *cv*. African tall was fertilized with RDF as 100: 50: 50 N, P and K kg ha^{-1}. RDN was applied at basal, at 15 and 30 days after sowing (DAS) as per treatment. A full dose of P_2O_5 and K_2O was applied as a basal dose. The source of nitrogen was applied through urea; while the source of phosphorus was applied through single super phosphate and potassium (SSP) was applied through muriate of potash (MOP). Data on a given set of parameters including yield and economics were tabulated and statistically analyzed by the technique of analysis of variance as described by (Gomez and Gomez, 1984). The F values are significant at a 5% level of probability as given by (Panse and Sukhatme, 1995) in the tabular data. Critical difference (C.D.) values have been given for comparison only in the case where the "F" test was significant and figures of C.D. are not available where the "F" test was not significant, only standard error (S.E.) values are included.

Results and Discussion

Effect of Splitting Nitrogen

The effect of different nitrogen splitting treatments on green fodder yield (q ha^{-1}), dry matter content (%) and dry matter yield (q ha^{-1}) of fodder maize are presented in table 1.

The application of treatment (N_3) 50 % RDN at (basal) + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS to fodder maize recorded significantly higher green fodder yield (581.96 q ha^{-1}), dry matter content (21.61%) and dry matter yield (126 q ha^{-1}) as compared to other nitrogen splitting treatments. It was followed by application of 75 % RDN at (basal) + 12.5 % RDN at 15 DAS and 12.5 RDN at 30 DAS (N_2) treatments observed green fodder yield (522.86 q ha^{-1}), dry matter content (21.47 %) and dry fodder yield (112.51 q ha^{-1}). The fodder maize crop applied with treatment (N_1) 50 % RDN at (basal) + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS recorded lower green fodder yield (482.46 q ha^{-1}), dry matter content (21.28%) and dry matter yield (102.92 q ha^{-1}). The application of 50 % RDN at (basal) + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS (N_3). The yield parameters increase with more nitrogen splitting and supply of the right amount of nitrogen at various growth stages of maize. Splitting of nitrogen increases nitrogen use efficiency (NUE).

The nitrogen encourages plant development and grows longer and multiplies internodes (Adhikari *et al*., 2016). It may be beneficial because split application enhances nitrogen usage by minimizing loss and regulating crop demand and nitrogen supply. These outcomes match with the findings published by (Kuldeep *et al*., 2022). The data on the economic studies like gross monetary returns, net monetary returns and benefit: cost ratio of fodder maize impacted by various splitting of nitrogen is presented in table 2. The nitrogen splitting treatments, the treatment N_3 *i.e*., 50 % RDN at basal + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS recorded significantly higher gross monetary returns (₹ 192045 ha^{-1}), net monetary returns (₹ 117740 ha^{-1}) and benefit: ratio (2.58) than other treatments.

The treatment N_2 *i.e*., application of 75 % RDN at (basal) + 12.5 % RDN at 15 DAS and 12.5 RDN at 30 DAS which observed (₹ 172544, 98238 ha^{-1} and 2.32), respectively. Lowest gross and net monetary returns and benefit: cost ratio reported by N_1 *i.e*., application of 50 % RDN at basal + 50 % RDN at 30 DAS (₹ 159211, 85965 ha^{-1} and 2.17), respectively. The treatment N_1 recorded the minimum cost of cultivation (₹ 73245).

Effect of Harvesting Time

Harvesting of fodder maize yield parameters such as green fodder yield (q ha^{-1}), dry matter content (%) and dry matter yield (q ha^{-1}) were influenced significantly due to different harvesting times are represented in table 1. Harvesting at physiological maturity stage of fodder maize obtained significantly higher yield parameters like green fodder yield (580.58 q ha^{-1}), dry matter content (21.79%) and dry matter yield (126.95 q ha^{-1}) as compared to other remaining harvesting stages. It was statically at par with treatment harvesting at milk stage registered green fodder yield (551.12 q ha^{-1}), dry matter content (21.65%) as well as dry matter yield (119.13 q ha^{-1}). The fodder maize crop harvested at flowering stage showed significantly lower green fodder yield (455.56 q ha^{-1}), dry matter content (20.92%) as well as dry matter yield (95.34 q ha^{-1}). Due to more resources being available for metabolite synthesis, extended growth periods improved growth characteristics.

This led to increased plant height with thicker stems, which enhanced green fodder yield production with delayed harvesting time. A similar trend of results was recorded by (Azim *et al*., 2000, Saini, 2013 and Magar, 2021). The data on the economic studies *viz*., gross monetary returns, net monetary returns and benefit: cost ratio of fodder maize impacted by various splitting of nitrogen is presented in table 2. Harvesting at physiological maturity stage of the fodder maize earned significantly highest gross monetary returns (₹ 191591 ha^{-1}), net monetary returns (₹ 113787 ha^{-1}) and B: C ratio (2.47) than rest of the treatments during research. It was statically at par with treatment harvesting at the milk stage earned gross monetary returns (₹ 181869 ha^{-1}), net monetary returns (₹ 106928 ha^{-1}) and B: C ratio (2.43). Harvesting at the flowering stage earned significantly lower gross monetary returns (₹ 150340 ha^{-1}), net monetary returns (₹ 81228 ha^{-1}) and B: C ratio (2.18).

Interaction Effect

The interaction effects between the splitting of nitrogen and harvesting time with respect to yield and economic studies were found to be non-significant.

Table 1. Yield parameters of fodder maize as influenced by the different treatment

Treatments	Green Fodder Yield (q ha^{-1})	Dry Matter Content (%)	Dry Matter Yield (q ha^{-1})
A. Nitrogen Splitting			
N_1: 50 % RDN at (basal) + 50 % RDN at 30 DAS	482.46	21.28	102.92
N_2: 75 % RDN at (basal) + 12.5 % RDN at 15 DAS and 12.5 RDN at 30 DAS	522.86	21.47	112.51
N_3: 50 % RDN at (basal) + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS	581.96	21.61	126.00
S. Em. ±	11.72	0.24	2.84
C.D. at 5 %	35.14	NS	8.51
B. Harvesting Time			
C_1: Harvesting at flowering stage	455.56	20.92	95.34
C_2: Harvesting at milk stage	551.12	21.65	119.13
C_3: Harvesting at physiological maturity stage	580.58	21.79	126.95
S. Em. ±	11.72	0.24	2.84
C.D. at 5 %	35.14	0.73	8.51
C. Interaction Effect			
S. Em. ±	20.30	0.42	4.92
C.D. at 5 %	NS	NS	NS
General Mean	**529.08**	**21.45**	**113.80**

Table 2. Economics of fodder maize as influenced by the different treatment

Treatments	Gross Monetary Returns (₹ ha^{-1})	Net Monetary Returns (₹ ha^{-1})	B: C Ratio
A. Nitrogen Splitting			
N_1: 50 % RDN at (basal) + 50 % RDN at 30 DAS	159211	85965	2.17
N_2: 75 % RDN at (basal) + 12.5 % RDN at 15 DAS and 12.5 RDN at 30 DAS	172544	98238	2.32
N_3: 50 % RDN at (basal) + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS	192045	117740	2.58
S. Em. ±	3869	3869	-
C.D. at 5 %	11599	11599	-
B. Harvesting Time			
C_1: Harvesting at flowering stage	150340	81228	2.18
C_2: Harvesting at milk stage	181869	106928	2.43
C_3: Harvesting at physiological maturity stage	191591	113787	2.47
S. Em. ±	3869	3869	-
C.D. at 5 %	11599	11599	-
C. Interaction Effect			
S. Em. ±	6701	6701	-
C.D. at 5 %	NS	NS	-
General Mean	**174600**	**100648**	**2.36**

Conclusion

In view of the results observed from the research it can be concluded that application of 50 % RDN at (basal) + 25 % RDN at 15 DAS and 25 % RDN at 30 DAS and harvesting at the physiological maturity stage registered significantly highest yield parameters *viz*., green fodder yield (q ha^{-1}), dry matter content (%) and dry matter yield (q ha^{-1}) and economics studies like gross monetary return, net monetary returns and B: C ratio found beneficial to farmers.

References

Adhikari, P., Baral B. R and Shrestha J. (2016) Maize response to time of nitrogen application and planting seasons, *Journal Maize Research Development*, 2(**1**): 83-93.

Arya, R. K., Kamboj, M. C. and Kumar, S. (2020) Evaluation of new extra-early maturing hybrid maize (*Zea mays* L.) for grain yield and its contributing traits under humid and semi-arid conditions of Haryana, *Ekin Journal*, 6(**2**): 23-27.

Azim, A., Khan, A. G., Nadeem, M. A and Muhammad, D. (2000) Influence of maize and cowpea intercropping on fodder production and characteristics of silage, 13(**6**): 781-784.

Ball, D. M., M. Collins., G. D., Lacefield, N. P., Martin, D. A., Mertens, K. E., Olson, D., Putnam, H., Undersander, D. J and Wolf, M. W. (2001) Understanding Forage Quality American Farm Bureau Federation Publication 1-01, *Park Ridge, Illinois*, USA: 1-16.

Brewbaker, J. L. (2003) Corn production in the tropics: The Hawaii experience Honolulu (HI): University of Hawaii, pp: 76.

Gomez, K. A. and Gomez, A. A. (1984) Statistical procedures for agriculture research, 2nd edition, John Wiley and Sons, New York, pp: 680.

Hassan, S., W., Oad, F., C., Tunio, S., D., Gandhi, A., W., Siddiqui, M., Oad, M., S. and Jagirani, A., W. (2016) *Pakistan Journal of Botany*, 42(**6**): 4095-4101.

Kuldeep, N., Patel, H. K. C., Raval, H., Badi, A. R., Lakshman and Chaudhary, N. (2022) Response of FYM and split application of nitrogen on growth and green yield of fodder maize (*Zea mays* L.), *International Journal of Plant and Soil Science*, 34(**23**): 245-253.

Magar, P. H. (2021) Effect of cutting management and nitrogen levels on growth, yield and silage of forage maize under summer conditions, M.Sc. (agri.) S.).

Mandal, S. and Thakor, T. C. (2010) Effect of subsoiling, deep and different rate of placement of fertilizer on sugarcane crop response, *Journal Agriculture Eng*., 47(**1**): 9-13.

Methu, J. N., Kiruiro, E. M. and Abate, A. N. (2006) Your feed shortage problem: Use maize forage, KARI Resource Center, Nairobi.

Panse, V. G. and Sukhatme, P. V. (1985) Statistical methods for agricultural workers, 4th Edn., *ICAR Publication,* New Delhi, pp: 145-146.

Pathan, S. H., Tumbare, A. D. and Kamble, A. B. (2013) Impact of planting material, cutting management and fertilizer levels on nutritional quality of Bajra × Napier Hybrid, *Forage Research*, 38(**2**): 74-79.

Porte, C., Jha, S. K., Dwivedi, S. K. and Jaiswal, P. (2023) Effect of different nitrogen levels and planting geometry on growth parameters of African tall fodder maize (*Zea mays* L.), *The Pharma Innovation Journal*, 12(**12**): 3570-3574.

Ram, S. N. and Singh, B. (2003) Physiological growth parameters forage yield and nitrogen-uptake of sorghum influenced with legume intercropping, harvesting time and nitrogen level, *Indian Journal of Agronomy*, 48(**1**): 38-41.

Saini, A. (2013) Forage quality of sorghum (*Sorghum bicolor*) as influenced by irrigation, nitrogen levels and harvesting stage, *Indian Journal of Scientific Research*, 3(**2**): 67-72.

Sattar, M. A., Haque, M. F. and Rahman, M. M. (1994) Inter-cropping maize with broadcast rice at different row spacing, *Bangladesh Journal Agriculture Research*, **19**: 159-164.

Verma, A. K., Verma, R., Singh, U., Kumar, D. and Verma, R. (2023) Effect of cutting and splitting of nitrogen management on the quality of different varieties of fodder oat (*Avena sativa* L.), *International Journal of Environment and Climate Change*, 13(**9**): 2183-2189.

Wadi, A., Ishii, Y. and Idota, S. (2004) Effect of cutting interval and cutting height and dry matter yield and overwintering ability at the established year in *Pennisetum* species, *Plant Production Sci*ence, **7**: 88-96.

Witt, C., Pasuquin, J. and Dbermann, A. (2008) Site-specific nutrient management for maize in favorable tropical environments of Saia, Proceedings of the 5th inter, *Crop Science Congress*, pp: 1-4.