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Research Article

ON FARM ASSESSMENT OF FOLIAR APPLICATION OF UREA IN TORIA (*Brassica campestris* L.) UNDER RAINFED CONDITION IN HILL ZONE OF ASSAM

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Abstract: A study was carried out through participatory on farm testing during October-January (*rabi* season) of 2015-16 and 2016-17 at 5 villages in Karbi Anglong district under hill zone of Assam in farmers' field with an objective to assess the effect of foliar application of urea on performances of Toria as compared to the soil application of recommended dose of fertilizers and farmer's practice. The results revealed that foliar application of N at 50% flowering and at 50% pod initiation stage with soil application of 50% recommended N and full dose of P & K was found significantly superior over recommended dose of fertilizer (RDF) and farmers practice in all the growth indices and yield attributing characters like plant height, dry matter accumulation, number of branches, number of siliquae per plant, seeds per siliqua and 1000 grain weight and ultimately resulted to higher yields. The same produced seed yield of 10.88 q ha^{-1} which is 50.06% and 10.79 % higher than farmers practice and RDF with stover yield 21.73 q ha^{-1} and harvest index (33.36%). The foliar feeding gave additional net return of Rs.3600.00 ha^{-1} and Rs 2430.00 ha^{-1} as compared to farmers practice and RDF respectively.

Keywords: *Toria, On farm testing, Foliar application, Harvest index*

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Introduction

In Assam, Toria (*Brassica campestris* L.) is cultivated in 2.81 lakh ha with a production and productivity of 1.88 lakh MT and 6.67qha^{-1}, respectively which is lower than the national average of 1176 kg ha^{-1} [1, 2]. Mustard crop is most sensitive to moisture stress from vegetative to early flowering stage when it is grown under a wide variety of limited irrigation conditions. Poor nutrient management under rainfed condition resulting low nutrient use efficiency is one of the major reason for low productivity of the crop in Hill Region of Assam. Soil moisture depletion under delayed sowing adversely affects the efficiencies of the applied fertilizers and thus affecting flowering, siliqua formation and seed filling [3]. Of the major elements, nitrogen which is insufficient in most of the Indian soils plays an appreciably important role in Brassica crops. Nitrogen is the most energy intensive element and various losses in the form of volatilization, leaching and fixation are more often with this than any other nutrient element. About 50% of the applied nitrogen to the soil remains unavailable to crop because of combination of leaching, fixation and volatilization. Foliar application of dilute solution of urea as supplementary to the basal application of urea can significantly reduce such wastages [4]. Besides, foliar fertilization is environment friendly, immediate and target-oriented than soil application as the nutrients are directly delivered to the plant tissues [5]. In spite of cultivation of high yielding varieties, improved cultural practices and plant protection measures the productivity of toria is very low in Karbi Anglong district which falls in hill region of Assam. One of the major constraints for low yield in the hill district of Assam is moisture stress under rainfed condition and moisture stress induced low use efficiency of applied nutrients. Due to limited moisture in the root zone, the basal dose of fertilizers may not be very effective. Foliar supply of nutrients can increase the photosynthetic efficiency by delaying the onset of senescence of leaves.

Hence a study has been made to assess the effect of foliar application of urea on performances of Toria as compared to the soil application of recommended dose of fertilizers in farmers' field under rainfed condition as toria is cultivated entirely as rainfed crop in the district.

Materials and Methods

Field experiment was conducted during October – January (rabi season) of 2015-16 and 2016-17 at 5 villages in Karbi Anglong district under hill zone of Assam on farmers field. The experimental soils of the farmers field were sandy loam to clay loam with pH 5.35 to 5.70, medium in organic carbon (0.56 to 0.78%) medium in available N (265.8 to 298.30 $kgha^{-1}$), low in available P_2O_5 (6.20 to 10.33 $kgha^{-1}$) and medium in available K_2O (138.0 to 247.6 $kgha^{-1}$). The experiment was conducted in three farmers' field in each year as replication with four treatment combinations. The treatment combinations were: T1- Recommended NPK only, T2- Recommended NPK + foliar application of 2 % urea at 50% flowering, T3- 50% of recommended N + Full P & K + foliar application of 2 % urea at 50% flowering & 50 % pod initiation stage and T4- Farmers cultivation practice. The farmers cultivation practice is application of only farm yard manure (FYM) @ 2 t ha^{-1}. A uniform basal application of whole amount of phosphorus in the form of single super phosphate and whole amount of potassium as muriate of potash and nitrogen in the form of urea as per treatment was applied. Observations on different growth and yield parameters *viz.* plant height, number of branches per plant, siliqua per plant, seeds per siliqua and 1000 seed weight were taken and economic analysis was done by calculating cost of cultivation, gross return, net return and benefit to cost ratio (B: C ratio). Available soil nutrients as well as nutrient content were determined following the standard procedures [6].

Table-1 *Effect of different nutrient levels and foliar application of N on growth and yield attributes on toria (pooled data of two years)*

Treatment	Plant height (cm)	Branches/plant (No.)	Siliqua/plant (No.)	Seeds/siliqua (No.)	1000 seed weight
Recommended NPK only	74.23	4.57	134.67	7.13	4.18
Recommended NPK + foliar application of urea at 50% flowering	76.33	4.11	144.56	8.27	4.53
50% of recommended N + Full P & K + foliar application of urea at 50% flowering & 50 % pod initiation stage	76.46	4.36	148.87	8.84	4.75
Farmers practice	64.12	2.96	118.36	5.33	3.89
SEm±	0.91	0.18	3.54	0.27	0.22
$CD_{5\%}$	2.06	NS	10.01	0.53	NS

Table-2 *Effect of different nutrient levels and foliar application of N on yield and economics on toria (pooled data of two years)*

Treatment	Seed Yield (kg/ha)	Stover yield(kg/ha)	Harvest Index (%)	Gross cost(Rs/ha)	Gross return(Rs/ha)	Net return(Rs/ha)	B:C ratio
Recommended NPK only	982	1983	33.11	15180	29460	14280	1.94
Recommended NPK + foliar application of urea at 50% flowering	1024	2097	32.88	15430	30720	15290	1.99
50% of recommended N + Full P & K + foliar application of urea at 50% flowering & 50 % pod initiation stage	1088	2173	33.36	15930	32640	16710	2.05
Farmers practice	725	1245	36.80	11640	21750	13110	1.87
SEm±	11.33	28.46	-	-	-	-	-
$CD_{5\%}$	37.0	148.0	-	-	-	-	-

Final crop yield (seed & stover) were recorded and the gross return were calculated on the basis of prevailing market price of the produce. Harvest index is the relationship between economic yield and biological yield [7]. It was calculated by using the following formula;

Harvest index (%)=(Economic yield)/(Biological yield) X 100

The experimental data were pooled over two growing seasons and statistically analyzed applying the techniques of analysis of variance and the significance of different sources of variations were tested by error mean square of Fisher Snedecor's 'F' test at probability level 0.05 [8,9].

Results and discussions

Growth attributes

Plant height at maturity varied significantly in different treatments. Foliar application of urea at 50% flowering & 50 % pod initiation stage along with 50 % N and full dose of P & K as basal registered the highest plant height and was at par with that of single foliar application of urea at 50% flowering stage along with RDF [Table-1]. No significant variations in branches plant^{-1} of toria was recorded for the effect of RDF and foliar spray of urea. The highest numbers of branches were obtained with the application of fertilizer against farmers practice. Higher level of nitrogen might have ensured the favourable condition for growth of toria resulting in the maximum number of branches [10,11]. Cell division and cell expansion are the two key physiological processes responsible for growth. For these two, nitrogen is of prime requirement. Probably nitrogen supplementation through foliar application resulted in better growth [12-15]. All the growth indices showed superiority under foliar application of nitrogen over that of soil application which might be due to better absorption of nitrogen that is directly delivered to the plant tissues during critical stages of plant growth.

Yield components

Application RDF and foliar application of urea at different stages showed a statistically significant variation in number of siliqua plant^{-1}, seeds siliqua^{-1} and the increase in 1000 seed weight was statistically non-significant. The highest number of siliqua plant^{-1} was obtained from basal application of 50% of recommended N + Full P & K + foliar application of urea at 50% flowering & 50 % pod initiation stage which was at par with recommended NPK + foliar application of urea at 50% flowering. Two foliar sprays of urea when applied with 50% of recommended N + Full P & K significantly increased the number of siliqua plant^{-1} as compared to soil application of RDF alone. The highest number of seeds siliqua^{-1} was produced by the application 50% of recommended N + Full P & K + foliar application of urea at 50% flowering & 50 % pod initiation stage which was at par with recommended NPK + foliar application of urea at 50% flowering. No significant difference was obtained in case of 1000 seed weight [Table-2]. The entire yield attributes *viz.* total number of branches plant^{-1}, total number of siliqua plant^{-1} and 1000-seed weight was found maximum for two foliar sprays. It might be because two foliar sprays would have sufficed the supply of nitrogen to the plants for production of enough photosynthates to put forth more branches which led to production of more number of siliquae plant^{-1} [16, 17]. 1000-seed weight is a function of metabolic activities and sink-source balance of the plant. Two foliar sprays supplemented plants with nitrogen and also proved efficient to maintain sink-source relationship which resulted in higher 1000-seed weight [18]. However, the increase in 1000 seed weight in treatments receiving foliar fertilization was not significant as it is mostly a genotypic character. The treatments under farmers practice suffered both moisture stress as well as nutrient stress due to low nutrient availability under limited moisture condition which resulted lowest values in respect to all the observed variables.

Seed yield, straw yield and harvest index

Foliar application of urea showed significant increase in seed yield of toria [Table - 2]. The highest seed yield was recorded in the treatment 50% of recommended N + Full P & K + foliar application of urea at 50% flowering & 50 % pod initiation stage. This was 6.25, 10.79, and 50.0% higher over that of recommended NPK + foliar application of urea at 50% flowering, recommended NPK only and Farmers practice respectively. Higher seed yield might be due to greater number of siliqua plant^{-1} and seeds siliqua^{-1}[19]. The stover yield also showed the similar result [20]. However, the highest harvest index was recorded in farmers' practice. The foliar spray of urea applied in combination with soil application of 50% recommended N showed higher harvest index over soil application of recommended NPK. All the yield attributes were recorded higher with the foliar sprays of 2% urea solution. Correspondingly seed yield was found highest in the combination of soil application of fertilizers and two sprays of 2% urea solution. Significant increase in yield with foliar application of nitrogen, phosphorus, potassium and sulphur were reported in peanut [21], mustard [22] and in yellow sarson [23]. The nutrient stress particularly nitrogen under rainfed dry condition was compensated through foliar application of urea in two critical stages *viz.* 50 % flowering and pod initiation stage, which resulted better plant growth and yield of the crop.

Economics

Highest cost of cultivation was incurred in the treatment 50% of recommended N + Full P & K + foliar application of urea at 50% flowering & 50 % pod initiation stage due to obvious reason of more labourer requirement for spraying and thereby higher cost involved in the treatment. But the gross and net returns were highest from this treatment with highest benefit: cost ratio (2.05) followed by recommended NPK+ foliar application of urea at 50% flowering (1.99), soil application of recommended NPK (1.94) and farmers practice (1.87) [Table-2].

Two foliar feedings gave additional net return of Rs.3600.00 ha^{-1} and Rs 2430.00 ha^{-1} as compared to farmers practice and RDF respectively. Similar, higher seed yield and net return with two foliar sprays of 2% urea under rainfed condition was also reported in mustard [24].

Conclusion

In hill region of Assam under rainfed dryland condition, application of 2% urea spray in addition to the soil application of recommended dose of P and K and 50 % of recommended N appears to be much effective for obtaining maximum yield of toria and high profit. Hence, two foliar applications of 2% urea will be viable and feasible option in order to get higher yield and economic return in toria under moisture stress condition.

Application of research: Efficient management of applied nutrients with higher use efficiency. Enhance productivity of toria crop under rainfed and moisture stressed condition in farmers field.

Research Category: Plant nutrient management

Abbreviations: RDF, B:C, NPK

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Study area / Sample Collection: Karbi Anglong, Assam, India

Cultivar / Variety / Breed name: Toria, Variety; TS- 36

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