

## ASSESSMENT OF WATER SOLUBLE NPK FOLIAR NUTRITION IN WHEAT (*Triticum aestivum* L.) THROUGH ON-FARM TESTING FOR IMPROVING YIELD AND ECONOMIC RETURNS

K.M. Sharma<sup>1\*</sup> and Mahendra Singh<sup>2</sup>

<sup>1</sup>Asstt. Professor (Agronomy), <sup>2</sup>Senior Scientist & Head,  
Krishi Vigyan Kendra, Borkhera, Kota (Rajasthan)-324001  
E-mail: kmsharma.kvk@gmail.com (\*Corresponding Author)

**Abstract:** An on-farm testing was conducted on farmer's fields of Kota district to assess the impact of foliar sprays of water soluble fertilizer on yield and profitability of wheat (*Triticum aestivum* L.) during rabi seasons of 2018-19 and 2019-20. Technology assessed in present study comprised of recommended doses of fertilizers (RDF- N 120, P 40 & ZnSo<sub>4</sub> 25 kg ha<sup>-1</sup>) followed by foliar application of NPK 19:19:19 @ 0.5% at tillering and spike initiation stages of wheat and a local check with only recommended doses of fertilizers (RDF and no sprays of NPK19:19:19). Results of two years data revealed that that RDF + two foliar application of NPK 19:19:19@ 0.5% recorded 8.30 per cent enhancement in grain yield over local check (48.99 q/ha). It was also observed that RDF+ foliar sprays of NPK improved yield attributes viz. no. of effective tillers (364/m<sup>2</sup>), no. of grains/ear (42.6) and test weight (45.14) over local check where these values were found to be 347, 39.5 and 44.03; respectively. Economic analysis revealed that additional cost of two foliar sprays of NPK19:19:19 work out to be Rs.2960/ha which in turn fetched additional returns of Rs.9403/ha with IBCR (3.18).

**Keywords:** NPK 19:19:19, On-farm testing, water soluble fertilizer, wheat.

### INTRODUCTION

With the ever increasing population and diminishing land availability, the agriculture sector in India is facing a serious challenge to produce more food from shrinking amounts of cultivated land. Wheat is a major contributor to the food security system and Indian economy, cultivated in 29.55 million hectares area and produced 101.20 million tonnes of wheat in 2018-19 (ICAR-IIWBR, 2019). However, growth rate and factor productivity in wheat are not encouraging. Wheat is a major *rabi* crop of the district Kota covering more than 50 per cent acreage of total *rabi* sown area. As per the average of last five years ending in 2016-17, wheat was cultivated in the area of 1.32 lakh ha with average productivity of 3716 kg ha<sup>-1</sup> in the Kota district (Anonymous, 2017). Despite of more than 95 per cent of its net sown area is irrigated and more than ninety percent acreage under high yielding varieties and use of recommended doses of N& P fertilizers, the productivity in the district is stagnated around 40-42 q ha<sup>-1</sup>. Balanced nutrition of plants is one of the most important factor determining

ultimate crop productivity. Soil application is most common method to supply essential nutrients to plant. However, foliar spray of one or more nutrients to supplement soil application of fertilizers has gaining more attention in recent years to overcome the problem of low fertilizer nutrient supply from soil to plant (Reena et al., 2018, Rajesh and Paulpandi,2013). Nutrients applied through the fertilizers at the time of sowing are not fully utilized by the crop and are lost through leaching, fixation etc. and the crop may suffer nutrients deficiency at the later stage. Foliar fertilizers can provide the plant nutrient at critical stages of plant growth where the nutrient requirement of plant exceeds the normal uptake for certain nutrients (Fageria et al.,2009). Supplemental foliar nutrition of nutrients is more advantageous than soil application due to better translocation from the leaves to the developing seeds and efficient utilization of nutrients (Manonmani and Srimathi, 2009). Recently, new generation water soluble fertilizers have been introduced specially for foliar sprays. NPK 19:19:19 fertilizer is available as hundred per cent water soluble complete fertilizer containing nitrogen, phosphorus and potassium each 19 per cent with low salt index. Nitrogen (N), phosphorus (P), and potassium (K) are primary nutrients in crop nutrition. Through on-farm testing, Krishi Vigyan Kendra carry out assessment on farmers' fields to draw conclusion which of the technologies tested is more suitable to the resources available in the district and economically profitable. This is a form of participatory study where farmers' perspective is given most importance. Keeping in view the above facts, present on-farm testing was conducted on farmer's fields of Kota district with the objective of assessment of the efficacy of foliar application of water soluble NPK fertilizer for improving yield and profitability of wheat (*Triticum aestivum* L.).

## **MATERIALS AND METHODS**

An on-farm testing was conducted by KrishiVigyan Kendra Kota during two consecutive *rabi* seasons of 2018-19 and 2019-20 to assess the efficacy of foliar application of water soluble fertilizer NPK 19:19:19 in wheat crop. Sites for the on-farm testing were selected based on the suitability and progressive attitude of the farmers in Charinda, Bagtari and Jorawarpura villages of the Kota district. Kota District falls under Agro-climatic Zone-V "Humid South-eastern plain zone" of Rajasthan. The climate in the district is semi-arid and moderate. Soils of the study area are clay loam in texture with low nitrogen, low to medium phosphorus, high in available potassium and widely deficient in zinc. In present on-farm testing, technology assessed comprised of application of recommended doses of fertilizers (RDF- N 120, P 40 & ZnSo<sub>4</sub> 25 kg ha<sup>-1</sup>) followed by foliar application of water soluble fertilizer NPK 19:19:19 @

0.5% at tillering and spike initiation stages of wheat crop and performance of this treatment was compared with the plots where only recommended doses of fertilizers (RDF- N 120, P 40 & ZnSo<sub>4</sub> 25 kg ha<sup>-1</sup>) were applied (no sprays of NPK19:19:19). The details of technological options assessed is as below-

T1 = Recommended doses of fertilizers (RDF- N 120, P 40 & ZnSo<sub>4</sub> 25 kg ha<sup>-1</sup>)

T2 =RDF + two foliar sprays of NPK (19:19:19) @ 0.5% at tillering and spike initiation

The OFTs were laid out on irrigated fields with soybean-wheat, paddy-wheat and blackgram-wheat rotations which are most prevalent in the area. On selected farmers fields, two plots of 0.16 ha each were made and both the plots were supplied with recommended doses of fertilizers (N 120 kg & P 40 kg ha<sup>-1</sup>). Soil application of zinc sulphate @ 25 kg ha<sup>-1</sup> was done at the time of last ploughing in Zn deficient fields as common treatment. Half of the recommended N dose and full dose of P fertilizer were applied as basal and remaining half dose of N was applied at the time of first irrigation (20-25 DAS). In one of the two such RDF applied plots, two foliar sprays of NPK 19:19:19 @ 0.5% were applied at two growth stages, first at tillering (45-50 DAS) and second at spike initiation stage (65-70 DAS) with a spray volume of 600 litres ha<sup>-1</sup>. Another plot was kept unsprayed plot of NPK (local check). Wheat varieties Raj-4079 and Raj-4037 were used under irrigated timely sown farming situation. Each treatment was replicated on six farmer field's during 2018-19 and on ten farmer fields in 2019-20. Beside one set of OFT was also laidout at KVK, Kota farm. The sowing was done during November month by drilling in 22.5 cm rows apart using seed rate of 100-120 kg ha<sup>-1</sup> and applied 3 to 4 irrigations at critical growth stages of the crop. Harvesting of crop was done during first fortnight of April. Data related to yield, yield attributes and cost particulars were collected separately for the foliar applied and local check plot. At physiological maturity, number of effective tillers (ear bearing shoots) were counted non-destructively from randomly selected one m<sup>2</sup> area in each plot. Randomly selected ten ears from each plots were threshed and grains were counted for determining the average number of grains ear<sup>-1</sup>. The grain samples were drawn from the produce of each plot while weighing the net plot yield. Thousand grains were counted from each of selected grain samples and weighed on an electric top pan balance to workout test weight (g). The average prices of inputs and outputs commodities prevailed during each year were taken for calculating cost of cultivation, net return and benefit cost ratio.

## RESULTS AND DISCUSSION

**Yield and yield attributes:** Data presented on yield and yield attributes (table.1) clearly reveals that RDF+ foliar application of NPK 19:19:19 recorded substantially higher grain yield over local check (RDF only) during both the years of on-farm assessment. Two foliar sprays of NPK (19:19:19) @ 0.5% at tillering & spike initiation stages in wheat crop recorded 7.65 and 8.98 percent increase in grain yield over local check during 2018-19 and 2019-20; respectively. On pooled basis, 53.06 qha<sup>-1</sup> grain yield was recorded under foliar NPK 19:19:19 applied plots which represents 8.30 per cent yield enhancement over local check (48.99 q ha<sup>-1</sup>). A perusal of data on yield attributes indicated positive influence of NPK19:19:19 foliar nutrition on no. of effective tillers m<sup>-2</sup>, no. of grains ear<sup>-1</sup> and test weight (g) over local check. On pooled basis, foliar application of NPK 19:19:19 shows 3.70, 7.84 and 2.52 per cent increase in no. of effective tillers m<sup>-2</sup>, no. of grains ear<sup>-1</sup> and test weight; respectively. However, the increase in these yield attributes were marginal and needs further research validation. Foliar application of nutrients along with recommended dose of fertilizers increased the yield components due to foliar spray as it facilitates the higher photosynthetic translocation to sink by increasing the photosynthesizing area and its capacity of particular crop (Thakur et al., 2017). Yield enhancement in wheat due to foliar application of NPK 19:19:19 on farmer fields was also reported by Sharma (2016).

**Table.1 Effect of foliar sprays of NPK 19:19:19 on yield attributes and yield of wheat**

Techno-logical options	No. of effective tillers m <sup>-2</sup>			No. of Grains ear <sup>-1</sup>			Test weight (g)			Grain yield (q ha <sup>-1</sup> )		
	Y1	Y2	P	Y1	Y2	P	Y1	Y2	P	Y1	Y2	P
T1	343	351	347	38.5	40.5	39.5	43.86	44.20	44.03	49.12	48.85	48.99
T2	358	369	364	41.2	43.9	42.6	44.93	45.35	45.14	52.88	53.24	53.06

Y1- 2018-19

Y2- 2019-20

P- Pooled mean

**Economic returns:** Based on average prices of inputs and output commodities prevailed during each year of assessment, values of economic indicators i.e. gross cost of cultivation, gross returns, net returns and B:C ratio are presented in table 2. Economic analysis clearly reveals that foliar application of water soluble NPK in wheat provided higher net returns over local check during both the years. This treatment fetched average net returns of Rs. 67554 ha<sup>-1</sup> which represents 10.24 increase over local check (Rs. 61112 ha<sup>-1</sup>). Additional cost of foliar

application of NPK worked out to be Rs.2900 and 3020 ha<sup>-1</sup> which in turn provided additional returns of Rs. 9026 and 9779 ha<sup>-1</sup> during 2018-19 and 2019-20; respectively. On pooled basis, foliar treatment provided additional returns of Rs.9403 ha<sup>-1</sup> with additional cost of only Rs.2960 ha<sup>-1</sup> and IBCR of 3.18. Overall B:C ratio were also found higher in foliar applied treatment over local check which clearly indicates that foliar application of water soluble NPK in wheat might be economically feasible and profitable techniques on farmer's fields. Sharma (2016) also reported NPK 19:19:19 to be economical at farmers fields in Rajasthan. Farmer's were also found highly convinced with the technological interventions due to higher economic returns with least additional investment and management practices. The variation in cost benefit ratio during different years might be due to variation in yield performance and input output cost in that particular year.

**Table.2 Economic analysis of foliar sprays of NPK 19:19:19 in wheat**

Particulars	2018-19		2019-20		Average	
	T1	T2	T1	T2	T1	T2
Gross cost (Rs. /ha)	30555	33455	31650	34670	31103	34063
Gross Returns (Rs./ha)	90389	99414	94039	103818	92214	101616
Net Returns (Rs.ha)	59834	65959	62389	69148	61112	67554
B:C Ratio	2.96	2.97	2.97	2.99	2.97	2.98
Additional cost of foliar sprays (Rs./ha)	-	2900	-	3020	-	2960
Additional returns due to foliar sprays(Rs./ha)	-	9026	-	9779	-	9403
Incremental Benefit Cost Ratio (IBCR)	-	3.11	-	3.24	-	3.18

## CONCLUSION

Based on the result of present investigation, it may be concluded that foliar application of water soluble NPK 19:19:19@ 0.5% at tillering and spike initiation stages in wheat along with recommended doses of fertilizer found to be yield remunerative and economically viable nutrient management option on farmers fields under irrigated farming situation of Kota district in Rajasthan. Research on foliar nutrition of one or more nutrients to supplement soil application of fertilizers may be strengthened to enhance the yield advantage.

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