



Research Article

EFFECT OF RECOMMENDED DOSE OF FERTILIZER AND WATER SOLUBLE NPK (19:19:19) SPRAY ON YIELD AND ECONOMICS OF WHEAT (*Triticum aestivum* L.)

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Abstract: The present study was carried out at farmers' fields of Dausa district of Rajasthan during three consecutive years i.e. Rabi 2015-16, 2016-17 and 2017-18 which falls in Agroclimatic zone IIIa (Semi arid eastern plain zone). The soils of the experimental fields were sandy loam in texture, alkaline in reaction (pH 8.9-9.1), low in organic matter (0.12 - 0.23), and nitrogen content and medium to high in potassium content. The study consists three treatments namely T₁- Farmers practice (N₁₂₀ P₃₅), T₂- Recommended practice (N₉₀ P₂₀), T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent. These treatments were replicated seven times during 2015-16 and ten times during 2016-17 and 2017-18 at farmers' fields. Treatment T₃ registered higher effective tillers per meter row length by the tune of 3.68, 5.40, 5.53 and 3.59 percent during 2015-16, 2016-17, 2017-18 and three years mean basis over treatment T₁, respectively. On the three years mean basis the treatment T₃ recorded 10.54 and 6.86 percent higher number of grains per ear over treatment T₁ and T₂, respectively. On three years mean basis treatment T₃ was recorded 11.63 and 13.84 percent higher grain yield over treatment T₁ and T₂, respectively and 9.42 and 11.62 percent higher fodder yield over treatment T₁ and T₂, respectively. On the three years mean basis treatment T₃ (Rs 109302/ha) recorded 11.01 and 13.25 percent higher gross returns over treatment T₁ and T₂, respectively. Similarly, on the three years mean basis treatment T₃ (Rs 63487/ha) recorded 12.92 and 15.02 percent higher net returns over treatment T₁ and T₂, respectively. On the three years mean basis treatment T₃ (2.41) recorded 2.55 and 2.12 percent higher B: C ratio over treatment T₁ and T₂, respectively.

Keywords: Wheat, Water soluble fertilizers, NPK (19:19:19), Yield attributes, Yield & Economics

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Introduction

Wheat (*Triticum aestivum* L) is an important staple cereal in India and realizable yield level at cultivators end in most part of the country (26.19 q/ha) and especially in Rajasthan (31.75 q/ha) are still deplorably low as compared to its genetic (60-70q/ha) and feasible (50-60 q/ha) potential [1], this calls for renewed efforts for analyzing the production constraints and evaluating location specific monetary and non-monetary technology for improving the existing productivity level. Wheat occupied 29.15 lac ha area with an annual production 109.39 lac tonnes with the productivity 3753 kg/ha in the state [2]. In the district Dausa, wheat is cultivated in 65 thousand hectares with 260000 tonnes of production with 4000 kg/ha productivity [3]. The productivity of the wheat is very low as compared to its attainable yields (60-65 q/ha), mainly because of use of low inputs and improper agronomic practices, declining water table, salinity and alkalinity of soil and poor quality of irrigation water and other factors related to climate change. Nitrogen, phosphorus and potassium are the major primary nutrient which is an important constituent of protein, chlorophyll and various enzymes involved in metabolic processes. Nitrogen being mobile nutrient in plant as well as in soil improves the vegetative as well as reproductive growth of the plant. Phosphorus is major constituent of sugar phosphate, nucleic acid and phospholipids [4]. Potassium not only helps in raising good crop but can help in escaping several diseases also. Recently foliar nutrition is getting prime importance due to greater awareness of soil and water pollution which is the resultant of indiscriminate use of soil applied fertilizers, water table depletion, soil alkalinity or salinity and adverse soil conditions which favours soil fixation of nutrients resulting depletion of crop yields. In such case of nutrient imbalance in soil complex the water-soluble fertilizer spray can give the better results because it is directly absorbed by the foliar portion of plant.

The nutrient present in the vegetative portion of the plant during early growth stage migrate to the grain or fruit during later stage of development. The foliar nutrient depletion affects photosynthesis in "flag leaf" in particular which supplies the major portion of photosynthesis to the grain [5].

Materials and Methods

The present study was carried out at farmers' fields of Dausa district of Rajasthan during three consecutive years i.e. Rabi 2015-16, 2016-17 and 2017-18 which falls in Agroclimatic zone IIIa (Semi-arid eastern plain zone) which covers the Jaipur, Dausa, Ajmer and Tonk district of Rajasthan. The soils of the experimental fields were sandy loam in texture, alkaline in reaction (pH 8.9-9.1), low in organic matter (0.12 -0.23), and nitrogen content and medium to high in potassium content. The study consists three treatments namely T₁- Farmers practice (N₁₂₀ P₃₅), T₂- Recommended practice (N₉₀ P₂₀), T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent. These treatments were replicated seven times during 2015-16 and ten times during 2016-17 and 2017-18 at farmers' fields. The trial was conducted in simple strips of 2500 sq meter for separate treatment during 2015-16 and 1000 sq meter for separate treatment during 2016-17 and 2017-18. The trial was conducted at farmers' fields of Norangwara village of Mahwa block and Bhedoli & Kalota village in Dausa block during 2015-16 and at Digo village of Lalsot block during 2016-17 and at Bada bad village of Lalsot block during 2017-18. The variety used for trial was Raj 4079 during 2015-16 and Raj 4037 during 2016-17 and 2017-18. The trial was sown in last week of November during 2015-16 and 2016-17 and first week of December during 2017-18.

Table-1 Effect of water soluble NPK (19:19:19) on yield attributes and yield of wheat

Treatments	Effective tillers/m row length				Ear length (cm)				Grains/ear				Test weight (g)				Grain yield (q/ha)				Fodder yield (q/ha)			
	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean
T ₁	122.3	122	123.2	122.5	9.83	9.97	9.96	9.92	45.9	46.7	46.8	46.5	38.5	39	39.6	39	41.57	46.5	46.5	44.86	47.43	57.9	51.6	52.31
T ₂	119.5	120.3	121.1	120.3	10.24	10.29	10.06	10.2	47.4	48.1	48.8	48.1	40.5	40.9	41.5	41	41.29	45.2	45.5	43.99	46.43	57.2	50.2	51.28
T ₃	126.2	126.8	127.8	126.9	10.94	10.9	10.43	10.76	50.8	51.3	52.1	51.4	42.9	43.1	43.7	43.2	47.14	52.4	50.7	50.08	55.43	60.7	55.6	57.24
SE _{ms}	1.02	1.14	1.08	-	0.23	0.19	0.12	-	0.27	0.31	0.43	-	0.8	0.92	0.87	-	0.98	0.88	0.85	-	1.46	1.56	0.75	-
CD at 5%	3.62	4.05	3.83	-	0.82	0.67	0.43	-	0.96	1.1	1.53	-	2.84	3.27	3.09	-	3.47	3.14	3.06	-	5.2	5.55	2.66	-

T₁- Farmers practice (N₁₂₀P₃₅), T₂- Recommended practice (N₉₀P₂₀),T₃- T₂ + Soluble fertilizer NPK (19:19:19) spray at tillering & ear head emergence stage @1.5%

Table-2 Effect of water soluble NPK (19:19:19) on economics of wheat

Treatments	Cost of cultivation (Rs/ha)				Gross returns (Rs/ha)				Net returns (Rs/ha)				B:C Ratio			
	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean
T ₁	36744	39394	50567	42235	86070	101617	107685	98457	49326	62223	57118	56222	2.34	2.58	2.13	2.35
T ₂	36349	37944	49650	41314	85150	99190	105195	96512	48801	61246	55545	55197	2.34	2.61	2.12	2.36
T ₃	40649	42544	54250	45814	98425	112465	117015	109302	57776	69921	62765	63487	2.42	2.64	2.16	2.41

T₁- Farmers practice (N₁₂₀P₃₅), T₂- Recommended practice (N₉₀P₂₀),T₃- T₂ + Soluble fertilizer NPK (19:19:19) spray at tillering & ear head emergence stage @1.5%

The crop was harvested during last week of March to first week of April during all three consecutive years of the trial. The sale price of wheat grain was Rs. 1500/q during 2015-16, Rs. 1625/q during 2016-17 and Rs. 1650/q during 2017-18. The sale price of wheat fodder was Rs. 500/q during 2015-16, Rs. 450/q during 2016-17 and Rs. 600/q during 2017-18. The observations of yield attributes and grain and straw yield were recorded in separate strip of the treatment and recorded as replication wise. The cross-section data on output of wheat crop and input used per hectare have been collected and used for further calculation of cost of cultivation, gross returns, net returns, and benefit cost ratio. The benefit cost ratio (B:C) was calculated dividing by gross monetary returns by the total cost of cultivation.

Results and Discussion

Yield attributes and yield / Effective tillers/m row length

Data presented in [Table-1] revealed that treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent which was significantly superior over treatment T₁- Farmers practice (N₁₂₀ P₃₅) and treatment T₂- Recommended practice (N₉₀ P₂₀) during all the three consecutive years of the trial. Treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent recorded 3.68, 5.40, 5.53 and 3.59 percent higher effective tillers/m row length over treatment T₁- Farmers practice (N₁₂₀ P₃₅) during 2015-16, 2016-17, 2017-18- and three-year mean basis, respectively.

Ear length (cm)

Data in [Table-1] reveals that the maximum ear length was recorded with treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent which was significantly superior over treatment T₁- Farmers practice (N₁₂₀ P₃₅) during all the three consecutive years of the trial. Treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent recorded 11.29, 9.46, 4.72 and 8.47 percent higher ear length over treatment T₁- Farmers practice (N₁₂₀ P₃₅) during 2015-16, 2016-17, 2017-18- and three-year mean basis, respectively.

Grains/ear

The maximum grains/ear was recorded with treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent which was found significantly superior over treatment T₁- Farmers practice (N₁₂₀ P₃₅) during all three years of the trial. Treatment T₃ recorded 10.68, 9.85 and 11.3 percent higher grains/ear over treatment T₁ during 2015-16, 2016-17 and 2017-18, respectively. On the three years mean basis the treatment T₃ recorded 10.54 and 6.86 percent higher number of grains per ear over treatment T₁ and T₂, respectively.

Test weight (g)

[Table-1] reveals that the highest test weight was recorded with treatment T₃-

Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent which was significantly superior over treatment T₁- Farmers practice (N₁₂₀ P₃₅) during all three years of the trial. The treatment T₃ recorded 11.43, 10.51 and 10.35 percent higher over treatment T₁ during 2015-16, 2016-17 and 2017-18, respectively. On the three years mean basis treatment T₃ recorded 10.77 and 5.37 percent higher test weight over treatment T₁ and T₂, respectively.

Grain yield (q/ha)

[Table-1] revealed that the grain yield was recorded the highest with the treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent which was significantly superior over treatment T₁- Farmers practice (N₁₂₀ P₃₅) and treatment T₂- Recommended practice (N₉₀ P₂₀) during all the three consecutive years of the trial. Treatment T₃ recorded the 13.40, 12.69 and 9.03 percent higher grain yield over treatment T₁ during 2015-16, 2016-17 and 2017-18, respectively. On three years mean basis treatment T₃ was recorded 11.63 and 13.84 percent higher grain yield over treatment T₁ and T₂, respectively. The similar results were also recorded by Das and Jana [6] by foliar spray of water-soluble fertilizer on pulses and Kharab [7] while working on wheat and Jat, [8] while working on barley.

Fodder yield (q/ha)

Fodder yield was recorded maximum with treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent which was significantly superior over treatment T₁- Farmers practice (N₁₂₀ P₃₅) during all the three consecutive years of the trial. The treatment T₃ recorded 16.87, 4.84 and 7.75 percent higher fodder yield over treatment T₁ during 2015-16, 2016-17 and 2017-18, respectively. On the three years mean basis treatment T₃ was recorded 9.42 and 11.62 percent higher fodder yield over treatment T₁ and T₂, respectively.

Economics of the barley

Cost of cultivation (Rs/ha)

[Table-2] reveals that the maximum cost of cultivation was recorded with treatment T₃ followed by treatment T₁ and T₂ during all three consecutive years of the trial and mean basis also. Treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent was recorded 10.63, 7.99 and 7.28 percent higher cost of cultivation as compared to treatment T₁- Farmers practice (N₁₂₀ P₃₅) during 2015-16, 2016-17 and 2017-18, respectively. On the mean basis treatment T₃ recorded 8.47 and 10.89 percent higher cost of cultivation over treatment T₁ and T₂, respectively.

Gross returns (Rs/ha)

Treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent recorded the highest gross returns i.e. Rs. 98425, Rs. 112465 and Rs. 117015 during 2015-16, 2016-17 and 2017-18, respectively.

The treatment T₃ recorded 15.59, 13.38 and 11.24 percent higher gross returns over treatment T₂- Recommended practice (N₉₀ P₂₀) during 2015-16, 2016-17 and 2017-18, respectively. On the three years mean basis treatment T₃ (Rs 109302/ha) recorded 11.01 and 13.25 percent higher gross returns over treatment T₁ and T₂, respectively.

Net returns (Rs/ha)

[Table-2] revealed that treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent recorded the highest net returns i.e. Rs. 57776, Rs. 69921 and Rs. 62765 during 2015-16, 2016-17 and 2017-18, respectively. The treatment T₃ recorded 18.39, 14.16 and 12.99 percent higher net returns over treatment T₂- Recommended practice (N₉₀ P₂₀) during 2015-16, 2016-17 and 2017-18, respectively. On the three years mean basis treatment T₃ (Rs 63487/ha) recorded 12.92 and 15.02 percent higher net returns over treatment T₁ and T₂, respectively.

B:C Ratio

[Table-2] revealed that treatment T₃- Recommended practice (N₉₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent recorded the highest B:C ratio 2.42, 2.64 and 2.16 during 2015-16, 2016-17 and 2017-18, respectively. The treatment T₃ recorded 3.42, 2.33 and 1.41 percent higher B: ratio over treatment T₁ during 2015-16, 2016-17 and 2017-18, respectively. On the three years mean basis treatment T₃ (2.41) recorded 2.55 and 2.12 percent higher B: C ratio over treatment T₁ and T₂, respectively. Results indicated that the water soluble NPK fertilizer spray significantly increased the effective tillers/m row length, ear length, grains/ear, test weight, grain and fodder yield of the wheat. Foliar spray technique increased the nutrient translocation from source to sink thereby increased the yield attributes and yield of barley. Similar findings were also reported by Kharab [7] while working on wheat.

Conclusion

On the three years mean basis Soluble fertilizer NPK (19:19:19) spray at tillering & ear head emergence stage @1.5% recorded 11.01 and 13.25 percent higher gross returns over farmers practice and Recommended practice (N₉₀P₂₀) respectively.

Application of research: Study of management of collar rot to increasing productivity and production of groundnut in Dausa district of Rajasthan.

Research Category: Agriculture extension

Abbreviations: OFT: On Farm Trial, mt: million ton, m ha: million hectare.

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Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note - All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Dausa, 303 303

Cultivar / Variety / Breed name: Wheat (*Triticum aestivum* L.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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