

EFFECT OF RECOMMENDED DOSE OF FERTILIZER AND WATER SOLUBLE NPK SPRAY ON YIELD AND ECONOMICS OF BARLEY (*HORDEUM VULGARE*)

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SUMMARY

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 (N₄₅ P₂₀), T₂ - Recommended practice (N₆₀ P₂₀), T₃ - Recommended practice (N₆₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent. These treatments were replicated nine times during 2015-16 and ten times during 2016-17 and 2017-18 at farmers' fields. Treatment T₃ being statistically at par with Treatment T₂, registered higher ear length by the tune of 0.8, 1.0, 1.0 and 1.01 per cent during 2015-16, 2016-17, 2017-18 and three year mean basis over treatment T₁, respectively. On the three year mean basis the treatment T₃ recorded 9.52 and 3.85 per cent higher number of grains per ear over treatment T₁ and T₂, respectively. On three year mean basis treatment T₃ was recorded 23.21 and 18.07 per cent higher grain yield over treatment T₁ and T₂, respectively and 15.10 and 9.52 per cent higher fodder yield over treatment T₁ and T₂, respectively. On the three year mean basis treatment T₃ (Rs 96794/ha) recorded 21.39 and 16.10 per cent higher gross returns over treatment T₁ and T₂, respectively. Similarly on the three year mean basis treatment T₃ (Rs 61796/ha) recorded 25.10 and 16.88 per cent higher net returns over treatment T₁ and T₂, respectively. On the three year mean basis treatment T₃ (2.76) recorded 4.94 and 1.10 per cent higher B: C ratio over treatment T₁ and T₂, respectively.

Key words : Barley, water soluble fertilizer NPK (19:19:19), yield attributes, yield & economics

Barley (*Hordeum vulgare*) has become a viable crop now days for brewing industry for manufacturing malt especially in the state like Punjab, Haryana and Rajasthan. Barley is well known dual purpose crop *i.e.* food and feed for humans as well as animals. Barley flour is used in preparing chapaties and "Sattu" *i.e.* flour of roasted barley mixed with cold water added some sugar is a very good traditional drink earlier during hot summers in rural areas of Rajasthan, Haryana and Punjab. Barley grains are also used as concentrates for feeding livestock and poultry. Although, barley is considered a minor crop today but it can play an important role in increasing farmers income in near future as well as can play an important role in food security of the country. Barley occupied 0.91 m ha area with an annual production 1.66 m t (Anonymous, 2017). In Rajasthan it occupies 1.91 Lakh hectare and production 4.47 Lakh tones with 2329 kg/ha productivity. In the district Dausa, barley is cultivated in 6.37 thousand hectare with 20562 tonnes of production (Anonymous, 2017-18).

The productivity of the barley is very low as compared to its attainable yields (50-60 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 (Reddy and Reddy, 2001). 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 the 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 (Roy and Singh, 2006).

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 (N₄₅ P₂₀), T₂- Recommended practice (N₆₀ P₂₀), T₃- Recommended practice (N₆₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent. These treatments were replicated nine 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. The trial was conducted at farmers' fields of Mohanpura village of Lalsot block during 2015-16 and at Toda ganga, Salempura, Khatwa and Ralawas villages of Lalsot block during 2016-17 and at Bhedoli, Khadka, Sindoli villages of Dausa block and Toorwara in Bandikui block during 2017-18. The variety used for all the three consecutive years for trial was RD 2552. The trial was sown in Ist and IIIrd week of November during 2015-16, IIIrd and IVth week of November during 2016-17 and last week of November during 2017-18. The crop was harvested during IIIrd and IVth week of March during all three consecutive years of the trial. The sale price of barley grain was Rs. 1300/q during 2015-16 and 2017-18 and Rs. 1325/q during 2016-17, while for fodder Rs. 300/q during all three consecutive years of the trial. 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 barley 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

Ear length (cm) : Data in Table 1 reveals

that the maximum ear length was recorded with treatment T₃- Recommended practice (N₆₀ 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 (N₄₅ P₂₀) and statistically at par with treatment T₂- Recommended practice (N₆₀ P₂₀) during all the three consecutive years of the trial. Treatment T₃- Recommended practice (N₆₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent recorded 1.26, 1.64, 1.77 and 1.64 per cent higher ear length over treatment T₁- Farmers practice (N₄₅ P₂₀) during 2015-16, 2016-17, 2017-18 and three year mean basis, respectively. Treatment T₃ being statistically at par with Treatment T₂ registered higher ear length by the tune of 0.8, 1.0, 1.0 and 1.01 per cent 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 (N₆₀ P₂₀) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent which was being at par with treatment T₂- Recommended practice (N₆₀ P₂₀) and found significantly superior over treatment T₁- Farmers practice (N₄₅ P₂₀) during all three years of the trial. Treatment T₃ recorded 8.16, 9.77 and 9.22 per cent higher grains/ear over treatment T₁ during 2015-16, 2016-17 and 2017-18, respectively. On the three year mean basis the treatment T₃ recorded 9.52 and 3.85 per cent 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 (N₆₀ 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 (N₄₅ P₂₀) during all three years of the trial. The treatment T₃ recorded 6.10, 9.11 and 8.17 per cent higher over treatment T₁ during 2015-16, 2016-17 and 2017-18, respectively. On the three year mean basis treatment T₃ recorded 7.75 and 2.19 per cent 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 (N₆₀ 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 (N₄₅ P₂₀) and statistically at par with treatment T₂-

TABLE 1
Effect of water soluble NPK (19 : 19 : 19) on yield attributes and yield of barley

Treatments	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				
T ₁ -Farmers practice (N ₄₅ P ₂₀)	7.90	7.90	7.92	7.91	47.56	47.1	47.7	47.25	42.0	39.5	40.4	40.63	46.22	46.1	47.35	46.56	52.44	63.2	63.9	59.85
T ₂ -Recommended practice (N ₆₀ P ₂₀)	7.94	7.97	7.98	7.96	48.89	49.9	50.7	49.83	43.22	42.4	42.9	42.84	47.77	48.1	49.9	48.59	55.89	66.0	66.8	62.90
T ₃ -T ₁ +Soluble fertilizer NPK (19 : 19 : 19) spray at tillering & ear head emergence stage @ 1.5%	8.00	8.05	8.06	8.04	51.44	51.7	52.1	51.75	44.56	43.1	43.7	43.78	55.11	58.1	58.9	57.37	63.67	68.9	74.1	68.89
S. Em±	0.025	0.023	0.018	-	0.949	0.810	0.798	-	0.509	0.839	0.776	-	0.83	0.96	1.16	-	1.35	0.60	0.91	-
C. D. (P=0.05)	0.089	0.819	0.065	-	3.370	2.877	2.833	-	1.807	2.981	2.754	-	2.95	3.40	4.12	-	4.80	2.14	3.25	-

TABLE 2
Effect of water soluble NPK (19 : 19 : 19) on economics of barley barley

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
T ₁ -Farmers practice (N45P20)	30396	30396	30227	30340	78440	80043	80725	79736	48044	49647	50498	49396
T ₂ -Recommended practice (N ₆₀ P ₂₀)	30554	30554	30385	30498	81663	83533	84910	83369	51109	52979	54525	52871
T ₃ -T ₂ + Soluble fertilizer NPK (19 : 19 : 19) spray at tillering & ear head emergence stage @ 1.5%	34854	35154	34985	34998	93928	97653	98800	96794	59074	62499	63815	61796

Recommended practice ($N_{60} P_{20}$) during all the three consecutive years of the trial. Treatment T_3 recorded the 19.23, 26.03 and 24.39 per cent higher grain yield over treatment T_1 during 2015-16, 2016-17 and 2017-18, respectively. On three year mean basis treatment T_3 was recorded 23.21 and 18.07 per cent higher grain yield over treatment T_1 and T_2 , respectively. The similar results were also recorded by Das and Jana, 2015 by foliar spray of water soluble fertilizer on pulses and Kharab *et al.*, 2002 while working on wheat.

Fodder yield (q/ha) : Fodder yield was recorded maximum with treatment T_3 - Recommended practice ($N_{60} P_{20}$) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent which was significantly superior over treatment T_1 - Farmers practice ($N_{45} P_{20}$) and statistically at par with treatment T_2 - Recommended practice ($N_{60} P_{20}$) during all the three consecutive years of the trial. The treatment T_3 recorded 21.43, 9.02 and 15.96 per cent higher fodder yield over treatment T_1 during 2015-16, 2016-17 and 2017-18, respectively. On the three year mean basis treatment T_3 was recorded 15.10 and 9.52 per cent higher fodder yield over treatment T_1 and T_2 , respectively

Economics of the barley

Cost of cultivation (Rs/ha) : Table 2 reveals that the maximum cost of cultivation was recorded with treatment T_3 followed by treatment T_2 and T_1 during all three consecutive years of the trial and mean basis also. Treatment T_3 - Recommended practice ($N_{60} P_{20}$) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent was recorded 14.67, 15.65 and 15.74 per cent higher cost of cultivation as compared to treatment T_1 - Farmers practice ($N_{45} P_{20}$) during 2015-16, 2016-17 and 2017-18, respectively. On the mean basis treatment T_3 recorded 15.35 and 14.76 per cent higher cost of cultivation over treatment T_1 and T_2 , respectively.

Gross returns (Rs/ha) : Treatment T_3 - Recommended practice ($N_{60} P_{20}$) + 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. 93928, 97653 and 98800 during 2015-16, 2016-17 and 2017-18, respectively. The treatment T_3 recorded 19.75, 22.00 and 22.39 per cent higher gross returns over treatment T_1 during 2015-16, 2016-17 and 2017-18, respectively. On the three year mean basis treatment T_3 (Rs 96794/ha) recorded 21.39 and 16.10 per cent higher gross returns over treatment T_1 and T_2 , respectively.

Net returns (Rs/ha) : Table 2 revealed that treatment T_3 - Recommended practice ($N_{60} P_{20}$) + 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. 59074, 62499 and 63815 during 2015-16, 2016-17 and 2017-18, respectively. The treatment T_3 recorded 22.96, 25.89 and 26.37 per cent higher net returns over treatment T_1 during 2015-16, 2016-17 and 2017-18, respectively. On the three year mean basis treatment T_3 (Rs 61796/ha) recorded 25.10 and 16.88 per cent higher net returns over treatment T_1 and T_2 , respectively.

B : C Ratio : Table 2 revealed that treatment T_3 - Recommended practice ($N_{60} P_{20}$) + water soluble NPK (19:19:19) spray at tillering and ear head emergence stage @ 1.5 percent recorded the highest B:C ratio 2.69, 2.78 and 2.82 during 2015-16, 2016-17 and 2017-18, respectively. The treatment T_3 recorded 4.26, 5.70 and 5.62 per cent higher B: ratio over treatment T_1 during 2015-16, 2016-17 and 2017-18, respectively. On the three year mean basis treatment T_3 (2.76) recorded 4.94 and 01.10 per cent higher B: C ratio over treatment T_1 and T_2 , respectively.

Results indicated that the water soluble NPK fertilizer spray significantly increased the ear length, grains/ear, test weight, grain and fodder yield of the barley. 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 *et al.*, 2002 while working on wheat.

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