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NUTRIENT DYNAMICS AND PRODUCTIVITY OF BARLEY GENOTYPES AS INFLUENCED BY INM AND SOIL MOISTURE CONSERVATION PRACTICES IN RAINFED CONDITION OF SOUTHERN INDIA

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ABSTRACT
A field experiment was conducted during *rabi* season to study the "uptake and availability of nutrients in barley genotypes as influenced by integrated nutrient management and land management practices" in rainfed condition. The treatments comprised of two land management practices *viz*. broad bed and furrow, farmer's practice, two genotypes *viz*. DWRB – 73, BH - 902 and five integrated nutrient management practices *viz*. RDF (50:25:0 N:P_2O5:K_2O kg ha^{-1} + 7 t ha^{-1} FYM), 75% N through urea + 25% N through FYM and recommended P through inorganic, 50% N through urea + 50% N through FYM and recommended P through inorganic, 75% N through urea + 25% N through vermicompost and recommended P through inorganic, 50% N through urea + 50% N through vermicompost and recommended P through inorganic. Significantly higher total dry matter production (300.1g), productive tillers (108.5) and grain yield(2122 kg ha^{-1}) was obtained with genotype DWRB-73 sown on BBF with the application of RDF compared to rest of the treatment. Genotype DWRB-73 raised on broad bed and furrow along with the application of RDF recorded significantly higher uptake of nitrogen (70.3 kg ha^{-1}), phosphorus (19.1 kg ha^{-1}) and potassium (88.9 kg ha^{-1}).

INTRODUCTION

Barley has the widest ecological range of adaptation among the cereals, which is grown throughout the temperate and tropical regions of the world. It has low cost of production and input requirement, so it is preferred by the resource poor farmers in the country. The fertilizer consumption in India is grossly unbalanced and tilted more towards nitrogen, followed by phosphorus. This has implications on yield response to fertilizer as it decreases the crop quality and adversely affects the overall soil fertility and productivity. The over or imbalanced use of major nutrients and neglect of organic manures which otherwise provide imbalanced supply of nutrients to plants, rendered micro-nutrient deficiencies resulting into decreasing trend in fertilizer use efficiency. Inorganic fertilizer is not a complete substitute for organic matter and vice-versa and their role is complementary to each other (Mahapatra *et al.,* 1985). Application of organo-inorganic combination is very effective in realization of high yield and high responses to added nutrients (Sarkar *et al.*, 1997), while imbalance use of nutrients has detrimental effect. The high fertilizer cost, degradation in soil health, lack of sustainability and pollution have led to renewed interest in the use of organic manures as the inclusion of FYM and vermicompost with chemical fertilizers regulates the nutrient uptake, improves crop yields and physical environment of soil. With the above facts under consideration, these studies were therefore initiated to know the effect of integrated nutrient management on uptake, availability and crop yield. In view of this, an attempt was made to study the nutrient dynamics and productivity of barley genotypes as influenced by INM and soil moisture conservation practices in rainfed condition with the objectives *viz.*, to study the response of nutrient uptake of barley genotypes to INM, to evaluate the performance of barley genotypes under *in situ* moisture conservation practices and to work out the barley production.

MATERIALS AND METHODS

This experiment was conducted during *rabi* season of 2013-14 and 2014 -15 in farmer's field at model watershed, Neeralkatti village, Dharwad district of Karnataka at 15^{0} 33^{1} 31.61^{11} N latitude and of 74^{0} 54^{1} 39.64^{11} E longitude with an altitude of 672 m above the mean sea level on deep black soil. The experiment was laid out in split-split plot design with three replications involving two *in-situ* moisture conservation practices *viz.* L_1: broad bed and furrow (BBF), L_2: farmer's practice (flat bed) as main plots, two genotypes as sub plots *viz.* G_1: DWRB – 73 which is characterised as two row barley with grain/malting ability and G_2: BH - 902 which was characterised as six row barley with fodder and grain ability and five integrated nutrient management practices *viz.* N_1: RDF (50:25:0 N:P_2O_5:K_2O kg ha^{-1} + 7 t ha^{-1} FYM), N_2: 75% N through urea + 25% N through FYM and recommended P through inorganic, N_3: 50% N through urea + 50% N through FYM and recommended P through inorganic, N_4: 75% N through urea + 25% N through vermicompost and recommended P through inorganic, N_5: 50% N through urea + 50% N through vermicompost and recommended P through inorganic as sub-sub plots. The soil of the experimental site was medium black clay with pH (7.62), EC (0.54 dS m^{-1}), organic carbon content was (0.52 %), available N (260 kg ha^{-1}), P_2O_5 (15 kg ha^{-1}) and K_2O (304 kg ha^{-1}). The mean annual rainfall for the past 62 years at the Main Agricultural Research Station, Dharwad which is nearer to experimental field was 721.0 mm. Rain received during *kharif*-2013 and 2014 helped to store moisture in soil during *rabi* season.

For analysis of available N, P, K composite soil sample was collected from 0-30 cm depth before lay out of the experiment and analyzed for available nitrogen, phosphorus and potassium contents using alkaline permanganate method (Subbiah and Asija, 1956) Olsen's method (Jackson, 1967) and Flame photometer method (Muhr, 1965) respectively. Plant samples after recording dry matter were grind and used for estimation of nitrogen, phosphorus and potash uptake by using Modified Microkjeldhal method (Jackson, 1967), Vanadomolybdo phosphoric yellow colour method (Jackson, 1967) and Flame photometer (Jackson, 1973), respectively. The total biomass yield for each net plot was recorded at harvest. After threshing, grains were separated, cleaned and weighed. Total porosity was calculated using the following formula (Black, 1965) *i.e.* porosity = (1- BD/PD) x 100. Based on the current price of the main products and byproducts at harvest during both the years the gross income was calculated. The net returns ha^{-1} was calculated by deducting the cost of cultivation from gross returns ha^{-1}. To know the rate of return per rupee invested, benefit cost ratio was worked out by dividing the Gross returns (Rs. ha^{-1}) by total cost of cultivation (Rs. ha^{-1}). The data collected from the experiment at different growth stages and at harvest was subjected to statistical analysis as described by Gomez and Gomez (1984). Further statistically analysed data were subjected to DMRT. The means followed by the same lower case letters did not differ significant.

RESULTS AND DISCUSSION

Among the *in situ* moisture conservation practices, crop raised on broad bed and furrow (BBF) recorded significantly taller plant height (72.4cm), higher dry matter production per m row length (276.2 g) at harvest due to higher soil moisture status in BBF (Kadam *et al.*2000). Broad bed and furrow recorded significantly higher productive tillers (94.4) and grain yield (1757 kg ha^{-1}) compared to farmer's practice (Table 1). The yield increase was to the extent of 12.9 over farmer's practice. This could be attributed to improved performance of growth and yield parameters through adequate availability of nutrients and soil moisture throughout the growing season, which in turn, favourably influenced physiological processes and build up of photosynthates (Anjhu George, 2014 and Nadaf, 2013). Higher grain yield per unit area in BBF was cumulative effect of total dry matter production over its crop growth stages. Reduced lodging of wheat at maturity on raised beds also lead to improved yield attributing characters and yield (Singh, 2013). Additional sunlight entering the canopy during maturity stage resulted in better strength of the straw as a result of more drying of the soil around the base of the plant (Hobbs, 2003 and Kumar, 2013).

Broad bed and furrow recorded significantly higher uptake of nitrogen, phosphorus and potassium (63.7 kg ha^{-1}, 14.9 kg ha^{-1} and 82.0 kg ha^{-1}, respectively) compared to farmer's practice (59.9 kg ha^{-1}, 12.5 kg ha^{-1} and 78.8 kg ha^{-1}, respectively). The increase was to an extent of 6.3, 19.2 and 4.0 percent over farmer's practice (Table 2). Better availability of moisture in broad bed and furrow resulted in better uptake of nutrients. Similar results of higher uptake of nutrients were also observed by Hiremath *et al.* (2003).

The influence of *in situ* moisture conservation practices on available nitrogen, phosphorus and potassium was not significant. However, numerically higher available nitrogen, phosphorus and potassium was recorded with broad bed and furrow compared to farmer's practice (Table 2). This was due to higher uptake of nutrient by the crop resulting in lower availability of nutrients in *in situ* moisture conservation practices (Hulihalli and Patil, 2005). Influence of *in situ* moisture conservation practices on porosity of the soil was not significant. However, infiltration rate of the soil was significantly higher in broad bed and furrow (0.77 cm hr^{-1}) compared to farmer's practice. This was due to slightly raised bed created with BBF which increased the infiltration opportunity time.

Among the genotypes, BH - 902 recorded significantly higher plant height (72.7 cm) due to genetic makeup of the variety as a fodder (Naveen kumar *et al.* 2013) DWRB – 73 recorded significantly higher dry matter production per m row length (277.1 g) due to higher seed test weight contributed significantly to total dry matter production at harvest in comparison to BH – 902 (Singh *et al.* 2005). Genotype DWRB-73 recorded significantly higher productive tillers (94.7) and grain yield (1888 kg ha^{-1}) compared to genotype BH-902 (1415 kg ha^{-1}) (Table 1). The yield increase was to the extent of 33.4 percent over BH-902. During the individual years of 2013 (30.3%) and 2014 (36.4%) also, genotype DWRB-73 recorded significantly higher grain yield compared to BH-902. The difference in grain yield might be related to the variation in yield components which in turn, favourably influenced physiological processes and build up of photosynthates. The increased yield of genotype DWRB-73 was mainly due to significant increase in number of productive tillers per m row length, spike length and test weight compared to BH-902 (Ramesh Pal *et al.* 2013) Crop yield depends not only on the accumulation of photosynthates during the crop growth and development, but also on it's translocation in the desired storage organs. These intern, are influenced by the efficiency of metabolic processes within the plant (Humphreys, 1997). BH-902 recorded significantly low yield. This was particularly due to low mean values of several yield components.

DWRB-73 recorded significantly higher uptake of nitrogen (64.9 kg ha^{-1}), phosphorus (15.3 kg ha^{-1}) and potassium (82.5 kg ha^{-1}) compared to BH-902 (58.6, 11.9 and 78.1 kg ha^{-1}, respectively) (Table 2). This was due to inherent capacity of the genotype to absorb higher amount of nutrients during the crop growth period, which in turn influenced the higher dry matter production, yield and nutrient uptake by the crop

Table 1: Plant height, total dry matter production, productive tillers and grain yield of barley genotypes as influenced by integrated nutrient management under *in situ* moisture conservation practices (pooled data)

Treatment	Plant height at harvest	Total dry matter production at harvest(g m^{-1} row length)	Productive tillers (m^{-1} row length)	Grain yield (kg ha^{-1})	Porosity (%)	Infiltration rate (cm hr^{-1})
Main plot (Land management) – L						
L_1	72.4a	276.2a	94.4a	1757a	53.3a	0.77a
L_2	67.6b	256.5b	86.0b	1556b	52.8a	0.61b
S.Em +	0.47	2.27	0.30	32.5	0.10	0.01
Sub plot (Genotypes) – G						
G_1	66.9b	277.1a	94.7a	1888a	52.9a	0.69a
G_2	72.7a	253.9b	84.9b	1415b	53.0a	0.71a
S.Em +	0.23	2.05	0.40	13.9	0.06	0.03
Sub sub (INM) – N						
N_1	73.4a	277.5a	97.0a	1775a	53.3a	0.63a
N_2	71.0b	267.9b	92.0b	1674b	52.7a	0.67a
N_3	65.5c	253.6c	81.7c	1521c	53.2a	0.77a
N_4	72.3ab	273.4ab	94.5ab	1724ab	52.7a	0.68a
N_5	66.6c	255.2c	84.1c	1565c	53.1a	0.73a
S.Em +	0.42	2.00	0.88	17.5	0.18	0.05
Interaction (L x G x N)						
$L_1G_1N_1$	73.0de	300.1a	108.5a	2122a	53.9a	0.73ab
$L_1G_1N_2$	70.7e	287.9bc	101.3bc	2019b	53.2a	0.67ab
$L_1G_1N_3$	65.1g	273.4de	91.2d-f	1854c	53.4a	0.80ab
$L_1G_1N_4$	72.0de	295.7ab	105.0ab	2060ab	52.7a	0.60ab
$L_1G_1N_5$	66.2fg	277.3c-e	94.4de	1909c	53.3a	0.80ab
$L_1G_2N_1$	79.0a	273.8de	95.3de	1634cd	53.2a	0.73ab
$L_1G_2N_2$	76.0bc	265.2efg	89.7f-h	1535de	52.7a	0.73ab
$L_1G_2N_3$	70.7e	256.9fg	80.2kl	1381f	53.4a	0.93a
$L_1G_2N_4$	77.7ab	269.7de	92.7d-f	1591cd	53.2a	0.80ab
$L_1G_2N_5$	72.2de	251.3g	82.4i-k	1427f	53.2a	0.73ab
$L_2G_1N_1$	68.0f	280.1cd	96.3cd	1904c	52.8a	0.47b
$L_2G_1N_2$	66.1fg	270.9de	92.4d-f	1805c	52.3a	0.73ab
$L_2G_1N_3$	59.7h	252.7fg	81.0j-l	1658d	52.6a	0.67ab
$L_2G_1N_4$	66.6fg	275.9c-e	93.7de	1857c	52.5a	0.60ab
$L_2G_1N_5$	61.2h	257.4fg	83.7i-k	1695d	52.7a	0.80ab
$L_2G_2N_1$	73.8cd	256.2fg	87.9f-h	1438ef	53.2a	0.60ab
$L_2G_2N_2$	71.4de	247.5g	84.4i-k	1339f	52.7a	0.53b
$L_2G_2N_3$	66.3fg	231.5h	74.2m	1189g	53.3a	0.67ab
$L_2G_2N_4$	72.7de	252.4fg	86.5h-j	1389f	52.3a	0.73ab
$L_2G_2N_5$	67.1fg	235.0h	75.7lm	1230g	53.0a	0.60ab
S.Em +	0.84	4.00	1.76	35.0	0.36	0.11

*The means followed by the same lower case letter(s) in a column do not differ significant by DMRT; DAS: Days after sowing; L_1: BBF ; G_1: DWRB –73; L_2: Farmer's practice ;G_2: BH - 902; N_1:RDF (50:25:0 N:P_2O_5:K_2O kg ha^{-1} + 7 t ha^{-1} FYM); N_2:75% N through inorganics + 25% N through FYM and recommended P through inorganics; N_3:50% N through inorganics + 50% N through FYM and recommended P through inorganics; N_4: 75% N through inorganics + 25% N through Vermicompost and recommended P through inorganics N_5: 50% N through inorganics + 50% N through Vermicompost and recommended P through inorganics

(Solanki, *et al*. 1987). Availability of nitrogen, phosphorus and potassium was not significant for genotypes. Porosity and infiltration rate of soil did not differ significantly, among the treatments.

Among the INM practices, application of RDF (50:25:0 N:P_2O_5:K_2O kg ha^{-1} + 7 t ha^{-1}) recorded significantly taller plant height (73.4 cm) and higher dry matter production (277.5 g). This was due to relatively higher availability of nutrients and synthesis of growth promoting substances as a result of conjunctive use of organic and inorganic sources of nutrients resulted in better crop response and higher crop productivity in RDF application (Jambhekar and Bhiday,. 1992). Significantly more number of productive tillers (97.0) and higher grain yield (1775 kg ha^{-1}) was obtained with application of RDF (50:25:0 N:P_2O5:K_2O kg ha^{-1} + 7 t ha^{-1} FYM) which was on par with the application of 75% N through inorganics + 25% N through vermicompost and recommended P through inorganics. The grain yield of barley with RDF was more to an extent of 6.0, 16.7, 3.0 and 13.4 percent over N_2, N_3, N_4 and N_5, respectively. The factors mainly responsible for variation in the grain yield of barley are due to variations in the performance of yield components which had direct influence on the grain yield. Other factors which indirectly influenced the grain yield are growth attributes. The increase in yield and yield attributing characters with the application of vermicompost may be due to higher quantity of available major and minor nutrients (Vasanthi and Kumaraswamy, 1999 and Satish *et al*. 2010). Similar results were also reported by Gajendra Khidrapure *et al*., (2015) in maize.

Increased uptake of nutrients (N, P and K) by the application of RDF (50:25:0 N:P_2O_5:K_2O kg ha^{-1} + 7 t ha^{-1} FYM) which was on par with the application of 75% N through inorganics +

Table 2: Uptake and available N, P, K as influenced by integrated nutrient management under *in situ* moisture conservation practices in barley genotypes (pooled data)

Treatment	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})	Available N (kg ha^{-1})	Available P(kg ha^{-1})	Available K(kg ha^{-1})
Main plot (Land management) – L						
L_1	63.7a	14.9a	82.0a	274.2a	20.1a	315.5a
L_2	59.9b	12.5b	78.8b	271.8a	16.8a	314.3a
S.Em +	0.37	0.14	0.13	4.16	0.66	3.95
Sub plot (Genotypes) – G						
G_1	64.9a	15.3a	82.5a	274.8a	19.2a	316.4a
G_2	58.6b	11.9b	78.1b	274.4a	19.2a	316.2a
S.Em +	0.09	0.30	0.51	0.53	0.12	0.20
Sub sub (INM) – N						
N_1	65.1a	15.7a	83.9a	268.0c	16.1c	310.5c
N_2	62.0b	14.2b	80.9b	273.0b	18.2b	314.7b
N_3	58.2c	11.2c	76.4c	278.0a	21.0a	319.6a
N_4	64.9a	15.1a	82.9a	274.2b	19.0b	315.7b
N_5	58.5c	11.8c	77.4c	279.7a	21.9a	321.0a
S.Em +	0.38	0.22	83.9	1.02	0.36	0.84
Interaction (L x G x N)						
$L_1G_1N_1$	70.3a	19.1a	88.9a	269.5d-f	17.7d-f	310.2gh
$L_1G_1N_2$	67.2b	17.0b	84.8b	274.2b-e	19.9b-d	315.7b-g
$L_1G_1N_3$	63.9cd	14.2de	81.2de	280.0ab	22.8a	320.7ab
$L_1G_1N_4$	70.0a	18.4a	87.4a	273.0b-e	20.5b	317.1a-f
$L_1G_1N_5$	63.2d	15.1cd	82.0cd	281.2a	23.5a	322.6a
$L_1G_2N_1$	63.6cd	15.0cd	82.4cd	268.3ef	17.8d-f	311.7fh
$L_1G_2N_2$	60.6e	13.4ef	80.0d-f	274.2b-e	19.7b-d	315.1b-g
$L_1G_2N_3$	56.5f	10.5j	74.8ij	278.8ab	22.7a	319.8a-d
$L_1G_2N_4$	63.5cd	14.1de	82.4cd	275.3a-d	20.3bc	315.7b-g
$L_1G_2N_5$	57.3f	11.1ij	76.1hi	281.2a	23.3a	320.7ab
$L_2G_1N_1$	66.5b	15.7c	83.9bc	268.3ef	14.6gh	310.6gh
$L_2G_1N_2$	63.0d	14.3d-e	80.9de	271.8c-f	16.6fg	313.4e-h
$L_2G_1N_3$	59.8e	11.5h-j	76.3hi	276.5a-c	19.3b-e	318.3a-e
$L_2G_1N_4$	65.8bc	15.2cd	82.3cd	274.2b-e	17.1ef	314.9c-g
$L_2G_1N_5$	59.8e	12.0g-i	77.5gh	278.8ab	20.2bc	320.5a-c
$L_2G_2N_1$	60.2e	13.1e-g	80.4d-f	266.0f	14.3h	309.3h
$L_2G_2N_2$	57.3f	11.9g-i	78.1f-h	271.8c-f	16.6fg	314.7d-h
$L_2G_2N_3$	52.7g	8.5k	73.2j	276.5a-c	19.3b-e	319.6a-d
$L_2G_2N_4$	60.2e	12.6fh	79.5e-g	274.2b-e	18.0c-f	315.3b-g
$L_2G_2N_5$	53.8g	9.0k	74.0ij	277.7a-c	20.4b	320.1a-d
S.Em +	0.75	0.44	0.76	2.03	0.71	1.67

*The means followed by the same lower case letter(s) in a column do not differ significant by DMRT; DAS: Days after sowing ; L_1: BBF ; G_1: DWRB –73; L_2: Farmer's practice; G_2: BH - 902; N_1:RDF (50:25:0 N:P_2O_5:K_2O kg ha^{-1} + 7 t ha^{-1} FYM); N_2:75% N through inorganics + 25% N through FYM and recommended P through inorganics; N_3:50% N through inorganics + 50% N through FYM and recommended P through inorganics; N_4: 75% N through inorganics + 25% N through Vermicompost and recommended P through inorganics N_5: 50% N through inorganics + 50% N through Vermicompost and recommended P through inorganics

25% N through vermicompost and recommended P through inorganics followed by the application of 75% N through inorganics + 25% N through FYM and recommended P through inorganics (Table 2) was due to increased availability of nitrogen to the crop and higher biomass production. The lowest nitrogen uptake with the application of 50% N through inorganics + 50% N through FYM and recommended P through inorganics was due to lower availability of nitrogen to the crop and lower biomass production. The variations in nitrogen, phosphorus and potassium uptake with different integrated nutrient management practices might be attributed to their inherent capacity of soil to supply these nutrients during the crop growth period, which in turn influenced the dry matter production and nutrient uptake by the crop.

In the present study, 50% N through inorganics + 50% N through vermicompost and recommended P through inorganics recorded significantly higher available nitrogen (279.7 kg ha^{-1}) compared to rest of the integrated nutrient management practices and it was on par with 50% N through inorganics + 50% N through FYM and recommended P through inorganic (Table 1). The increase in available nitrogen due to application of vermicompost and FYM might be attributed to the greater multiplication of soil microbes which helps in converting organically bound nitrogen to inorganic form resulting in higher available nitrogen in the soil (Singh and Yadav, 2008; Yadav and Kumar, 2002; Chaturvedi and Chandel, 2005). The lower value of available nitrogen in treatment with RDF (50:25:0 N: P_2O_5: K_2O kg ha^{-1} + 7t ha^{-1} FYM) at harvest might be attributed to the maximum utilization of applied nutrient by the crop.

Significantly higher available phosphorus (21.9 kg ha^{-1}) was observed with application of 50% N through inorganics + 50% N through vermicompost and recommended P through inorganics compared to rest of the integrated nutrient management practices and it was on par with 50% N through inorganics + 50% N through FYM and recommended P through inorganics (Table 2). Higher available P in INM_4 was due to the release of organic acids during microbial decomposition of organic matter which might have helped in the solubility of native phosphorus. In addition, the organic anions compete with phosphate ions for the binding sites on the soil particles. The complex organic anions chelate Al^{3+}, Fe^{3+} and Ca^{2+} and decrease the phosphate precipitating power of these cations and thereby increase the phosphorus availability (Singh and Uttam, 1994 ;Mishra and Singh,1993).

Application of 50% N through inorganics + 50% N through vermicompost and recommended P through inorganic recorded significantly higher available potassium (321.0 kg ha^{-1}) compared to rest of the integrated nutrient management practices and it was on par with 50% N through inorganics + 50% N through FYM and recommended P through inorganics (Table 2). The build up of available potassium in soil was due to the beneficial effect of organic manures in releasing potassium due to the interaction of organic matter with clay and direct addition of potassium to the available pool of soil. Similar beneficial effects of organic manures on the available potassium content of soil was reported by Pawar, 1996 and Misra *et al*. 1982 with FYM and vermicompost respectively. Porosity and infiltration rate of soil did not differ significantly, among the treatments.

Among the interaction effect, genotype BH – 902 raised on broad bed and furrow (BBF) with the application of RDF (50:25:0 N: P_2O_5: K_2O kg ha^{-1} + 7 t ha^{-1}) recorded significantly taller plant. Significantly higher dry matter production, more productive tillers and higher grain yield was obtained with interaction of genotype DWRB-73 sown on BBF with the application of RDF (50:25:0 N:P_2O5:K_2O kg ha^{-1} + 7 t ha-1 FYM) (BBF x DWRB-73 x RDF, 2122 kg ha^{-1}) compared to rest of the interactions except it was on par with $L_1G_1N_4$, (2060 kg ha^{-1}) i.e. genotype DWRB-73 planted on BBF with the application of 75% N through inorganics + 25% N through vermicompost and recommended P through inorganics. The increase in grain yield with BBF x RDF was due to the improvement in moisture content as well as higher nutrient availability resulted in higher uptake of N, P, K and contributed to increased barley grain yield.

Genotype DWRB-73 raised on broad bed and furrow along with the application of RDF (50:25:0 N:P_2O_5:K_2O kg ha^{-1} + 7 t ha^{-1} FYM) *i.e.* BBF x DWRB-73 x RDF ($L_1G_1N_1$) recorded significantly higher uptake of nitrogen (70.3 kg ha^{-1}), phosphorus (19.1 kg ha^{-1}) and potassium (88.9 kg ha^{-1}) and it was on par with genotype DWRB-73 planted on broad bed and furrow along with the application of 75% N through inorganics+ 25% N through vernicompost and recommended P through inorganics (Table 1). During individual years of 2013 and 2014 also, similar trend was noticed. These results are in agreement with the findings of Agarwal and Arora (1980), Paulpandi *et al*. (2009) and Shah *et al.,* (2015). Irrespective of land management and genotypes, the plots which received 50 percent N through urea + 50 percent N through vernicompost and recommended P through inorganics recorded significantly higher available nitrogen, phosphorus and potassium compared to rest of the interactions except that was on par with the application of 50% N through inorganics + 50% N through FYM and recommended P through inorganics (Table 2).

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