

Original Research Article

<https://doi.org/10.20546/ijcmas.2021.1002.082>

Studies on Preparatory Tillage, Nutrient Managements and Moisture Conservation Practices as Response on Yield, Effective Fresh and Dry Weight of Barley Cultivation under Water Stress Condition

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ABSTRACT

A field experiment were conducted for two consecutive rabi seasons during 2017-18 and 2018-19 at Soil Conservation and Water Management farm, C.S. Azad University of Agriculture and Technology Kanpur- 200 802 on Gangatic alluvial soil having 7.6 pH, light textured soil with medium soil fertility. Treatments comprises of viz., 3- preparatory tillage 1) T₁- one cross ploughing with cultivator, 2) T₂- one ploughing with disc harrow + one cross ploughing with cultivator and 3) T₃- one ploughing with disc harrow + one pass with rotavator, 3- nutrient management practices i.e. 1.) N₁-100% RDF (60 Kg N ha⁻¹ + 30 Kg P₂O₅ ha⁻¹ + 30 Kg K₂O ha⁻¹) (through chemical fertilizer), 2.) N₂-75% RDF (through chemical fertilizer) + 25% FYM (Farm yard manure) and 3.) N₃-50% RDF (through chemical fertilizer) +50% FYM (Farm yard manure) and 3- moisture conservation practices viz., 1.) M₁- Control, 2.) M₂- dust mulch and 3.) M₃-pinoxaden 5.1 EC @ 50 g ha⁻¹ + VAM @ 15 Kg ha⁻¹) was researches. It is clear from the results of two year experimentation that sowing of barley crop in plots where preparatory tillage, T₃- one ploughing with disc harrow + one pass with rotavator, nutrient applied as N₃-50% RDF (through chemical fertilizer) + 50% FYM (farm yard manure) and moisture conservation practices of M₃-pinoxaden 5EC @ 50 g/ha. + VAM @ 15 Kg/ha brought out the maximum values of grain yield, straw yield, biological yield, fresh and dry weight of barley observed during both the years of study respectively followed by T₂- one ploughing with disc harrow + one cross ploughing with cultivator, N₂ treatment- 75% RDF + 25% FYM and M₂- dust mulch, and minimum values of treatments i.e., T₁ - one cross ploughing with cultivator, N₁-100% RDF (60 Kg N ha⁻¹ + 30 Kg P₂O₅ ha⁻¹ + 30 Kg K₂O ha⁻¹) (through chemical fertilizer) and moisture conservation practices of M₁-control treatment in both year respectively.

Keywords

Preparatory tillage, T₁- one cross ploughing with cultivator, T₂- one ploughing with disc harrow + one cross ploughing with cultivator and T₃- one ploughing by disc harrow + one pass with rotavator, nutrient management practices

Article Info

Accepted:

07 January 2021

Available Online:

10 February 2021

Introduction

Barley is sown during October-November and harvested from March to April. India's annual production has been stable at 1.6 to 1.8 million metric tonnes in recent year during 2020, and 2019 it was 1687 and 1,633 thousand tonnes. The area under cultivation has also remained stagnant at 0.65-0.7 m ha, with a per-hectare yield of around 1,944 kg. In India, barley is largely grown in the states of Uttar Pradesh, Rajasthan and Madhya Pradesh, with a contribution of 34%, 30% and 12% respectively, in total acre. These states account for about 80% of the total acre. Although Uttar Pradesh ranks first in terms of acreage, barley tops in terms of production, due to good yield level in the state. Uttar Pradesh accounts for 34% of total production followed by Rajasthan (30%) and Madhya Pradesh (12%). (Anonymous, 2020). In the world, barley has share of 7% of the global cereals production. European Union-27 (EU-27) is the largest producer of barley in the world with a contribution of 42% followed by Russia (15%), Ukraine (8%), Canada (8%) and Australia (5%). In India, barley is cultivated as a winter crop. It is grown in a wide range of agro-climatic regions under several production systems, at altitudes of about 3000 MSL or above, it may be the only crop grown that provides food, beverages and other necessities to many millions of people. Barley grows best on well-drained soils and can tolerate higher levels of soil salinity than most other crops.

Food barley is commonly cultivated in stressed areas where soil erosion, occasional drought or frost limits the ability to grow other crops (Tapanarova, 2005). Investigated that the tillage during intermittent drought period effectively conserved the soil moisture and significantly increased the seed yield of *barley*. It is recommended that field bounding, deep ploughing during monsoon

and straw mulching @ 5 t ha⁻¹ may be followed for enhancement of *barley* seed yield and water productivity through *in-situ* moisture conservation (Regar *et al.*, 2009).

Barley (*Hordeum vulgare* L.) is an important *rabi* season cereal crop of dryland-agriculture due to its ability to tolerate the drought, fluctuation in temperature, biotic and abiotic stresses. Barley has been grown for centuries under stress conditions in marginal and problematic lands with the result that both natural and human selection have favored its development of types that are characterized more for their capacity to survive under low yielding environments with lower agromanagement conditions. A small portion of barley malt is used in food products principally to enhance flavor, however, the major use of barley malt is in the production of alcoholic beverages. Although alcoholic beverages are not foods. In the strict sense, they do contribute some nutrition, either with or a part from meals to the diet. It is also known to contain water soluble fiber (beta glucans) and oil compound (tocotrienols) which are found to be effective in lowering cholesterol level of blood. Barley straw is also used for making silage and hay. Its grains contain 8-10 per cent protein and 74 per cent carbohydrates besides minerals and vitamin B-complex, this is a forms of staple food, cattle feed, malt for manufacturing of beer and other liquor products. It is one of the first cereals to have been domesticated, have been cultivated for more than 10000 years, with archaeological evidence of barley cultivation in Iran as long ago as 8000 BC. Among the fertilizer nutrients, nitrogen is the nutrient that is absorbed in largest amount and is the most limiting factor for crop production. So it induces rapid growth, increases leaf size and improves quality, promotes fruit and seed development. The insufficient amount of nitrogen can reduce the quality below acceptable levels, while high nitrogen

fertilizer rates can result in translocation of sufficient amount of nitrogen from vegetative organs to the grain, resulting in high grain protein content.

Recorded highest content of soil moisture at the depths from 10 to 30 cm, in the zone of crop roots. As the consequence, favorable conditions for crop growth and yields were observed. Deep tillage of soil had positive effects on homogenous distribution of soil moisture along the vertical profile, independent of the crop type (Tapanarova, 2005), VAM are present in most terrestrial ecosystems and play a major role in community structure and function. However, their role in primary succession remains poorly understood. VAM colonization was more beneficial to plants under the complete nutrient treatment than under the tap water treatment (Titus, Jonathan H. and del Moral, Roger (1998)

A field experiment conducted “yield maximization through nutrient management in barley was carried out at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, and Junagadh during the *rabi* season of 2015-16.

The experiment comprising ten treatments of nutrient management *viz.*, T1 (control), T2 (RDF 120:60:60 NPK kg ha⁻¹), T3 (75% N from urea + 25% N from FYM), T4 (FYM @ 10 t ha⁻¹), T5 [RDF + ZnSO₄ @ 25 kg ha⁻¹ (P from DAP)], T6 [RDF + ZnSO₄ @ 25 kg ha⁻¹ (P from SSP)], T7 [RDF (N from Zn coated urea + P from SSP)], T8 (75% RDF + *Azotobacter* + PSB), T9 [RDF (N from neem coated urea + P from SSP)] and T10 (RDF 50% N from neem coated urea + 50% N from Zn coated urea + P from SSP) were evaluated in randomized block design with three replications. Akhtar, Nosheen *et al.*, (2018).

Materials and Methods

A field trail was conducted during (*rabi season*) of 2017-18 and 2018-19 at Soil Conservation and Water Management Farm of the *Chandra Shekhar Azad University of Agriculture and Technology*, Kanpur UP., on gangatic alluvial soil having 7.6 Ph, light textured soil with medium soil fertility. In Kanpur region average rainfall is approximately 800-850mm annually. Under the study programme treatments comprises of *viz.*, 3.) preparatory tillage- T₁- one cross ploughing with cultivator, T₂- one ploughing with disc harrow + one cross ploughing with cultivator and T₃ one ploughing with disc harrow + one pass with rotavator. 3.) nutrient management practices *i.e.* 1.) N₁ 100% RDF (60 Kg N ha⁻¹ + 30 Kg P₂O₅ ha⁻¹ + 30 Kg K₂O ha⁻¹) (through chemical fertilizer), 2.) N₂- 75% RDF (through chemical fertilizer) + 25% FYM (Farm yard manure) and 3.) N₃- 50% RDF (through chemical fertilizer) +50% FYM (Farm yard manure) and 3.) moisture conservation practices *viz.*, 1) M₁. Control, 2) M₂ . Dust mulch and 3) M₃- pinoxaden 5.1 EC @ 50 g ha⁻¹ + VAM @ 15 Kg ha⁻¹).

Experimental details

The experiment was laid down in Split Plot Design in a 3 replication 27 plot comprising 3 Preparatory tillage and 3 Nutrient managements with 3 Moisture conservation practices system.

Preparatory tillage (T): (i) one cross ploughing with cultivator, (ii) one ploughing with disc harrow + one cross ploughing with cultivator (iii) one ploughing by disc harrow + one pass with rotavator

Nutrient managements (N): (i) 100% RDF (60 Kg N + 30 Kg P + 30 Kg K /ha) (ii) 75% RDF + 25% FYM (iii) 50% RDF +50% FYM

Moisture conservation practices (M): (i) Control, (ii) Dust mulch (iii) Pinoxaden 5EC @ 50 g/ha + VAM @ 15 Kg/ha

Results and Discussion

Yield of barley crop

Effect of Preparatory tillage, Nutrient managements and Moisture conservation practices on grain yield, straw yield and biological yield of barley crop were analyzed statistically the results of both years have been presented in Table-1.

Among highest yield (grain yield (26.52 & 28.18 q/ha), straw yield (36.55 & 38.41 q/ha) & biological (62.34 & 66.60 q/ha) of preparatory tillage T₃) one ploughing with disc harrow + one cross ploughing with rotavator, followed by T₂) one ploughing with disc harrow + one cross ploughing with cultivator. While minimum grain yield (25.25 & 25.86 q/ha), straw yield (32.56 & 32.15 q/ha) & biological (57.60 & 57.01 q/ha) obtained a plots where T₁) one cross ploughing with cultivator during both year. As similar to Morell *et al.*, (2011), Bajwa *et al.*, (2002).

Among nutrient management treatments highest yield (grain yield (q/ha) (27.14 & 28.33), straw yield (q/ha) (36.72 & 39.30) and biological yield (q/ha) (63.49 & 67.64) of barley obtained in plots where N₃) 50% recommended dose of fertilizer of ploughed with 50% farm yard manure (FYM) followed by application of N₁) 75 percent fertilizer dose through chemical fertilizer with 25% farm yard manure however minimum grain yield (24.39 & 25.21), straw yield (q/ha) (31.78 & 32.09) and biological yield (q/ha) (56.19 & 57.30) of barley recorded under treatment N₁- 100% during 2017-18 & 2018-19 respected (Hemmat and Eskandari, 2006).

Various treatment of moisture conservation practices significantly affect the barley yield, maximum grain yield (27.60 & 27.77 q/ha), straw yield (q/ha) (37.78 & 38.63) and biological yield (q/ha) (65.41 & 66.40) of barley recorded in plots where M₃) pinoxaden 5EC @ 50g ha⁻¹ + VAM @ 15 Kg ha⁻¹ followed by M₂) dust mulch while minimum grain yield (23.66 & 25.64 q/ha), straw yield (30.90 & 32.63 q/ha) and biological yield (54.47 & 58.28 q/ha) recorded in plots where use moisture conservation practices of M₁) control during both the year of experimentation respectively.

Fersh and dry weight of barley

Effect of Preparatory tillage, Nutrient managements and Moisture conservation practices on fresh and dry weight of barley were analyzed statistically the results of both years have been presented in Table- 2 & 3.

It is clear from the results presented in table-2. that preparatory tillage treatment- T₃) one ploughing with disc harrow + one pass with rotavator, application of nutrient- N₁) 50% RDF +50% FYM and moisture conservation practices- M₃) pinoxaden 5.1 EC @ 50 g ha⁻¹ + VAM @ 15 Kg ha⁻¹ produced the highest Fresh weight plant⁻¹ (g) at, 60 DAS, 90 DAS and at maturity during both the years. The lowest Fresh weight plant⁻¹ (g) was noted in tillage treatment T₁) one cross ploughing with cultivator, nutrient management N₁)100% RDF (60 Kg N + 30 Kg P₂O₅ + 30 Kg K₂O ha⁻¹) and moisture conservation practices M₁) control at all the stages of observations during 2017-18 and 2018-19 respectively.

It is appear at from the data give in table-3 that dry weight (g) of increased with in crossed in day of sowing, preparatory tillage significantly increased the dry weight (g) of barley and record highest dry weight (g) (60, 90 DAS and maturity DAS) under treatment

T₃) one ploughing with disc harrow + one pass with rotavator followed by treatment T₂) one ploughing with disk harrow + one cross ploughing with cultivator. While lowest dry weight (g) per plant recorded under treatment T₁) one cross ploughing with cultivator. Among nutrient management treatment as increase organic matter as dry weight of plant. Highest dry weight was recorded with application of N₃) 50% RDF through chemical fertilizer + 50% FYM, followed by

N₂ treatment 75% RDF + 25% FYM. While minimum fresh weight of plant observed with application of N₁) 100% RDF through chemical fertilizer. Moisture conservation practices significantly affected the dry weight (g) plant of barley. Application of M₃) pinoxaden 5EC @ 50 g ha⁻¹ + VAM @ 15 Kg ha⁻¹ produced highest dry weight (g) per plant of barley and minimum under M₁) control during both the year of experiment respectively.

Table.1 Effect of preparatory tillage, Nutrient managements and moisture conservation practices on grain yield, straw yield and biological yield of barley

Treatments	Grain Yield		Straw Yield		Biological Yield	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
Preparatory Tillage (T)						
T₁ - One cross ploughing with cultivator	25.25	25.86	32.56	32.15	57.60	57.01
T₂ - One ploughing with disc harrow + one cross ploughing with cultivator	25.74	27.17	34.25	35.96	59.91	63.23
T₃ - One ploughing by disc harrow + one pass with rotavato	26.52	28.18	36.55	38.41	62.34	66.60
SE (d)	0.45	0.52	0.98	1.15	1.19	1.42
CD (P=0.05)	0.95	1.10	2.09	2.47	2.53	3.94
Nutrient Management (N)						
N₁ - 100% RDF	24.39	25.21	31.78	32.09	56.19	57.30
N₂ - 75% RDF + 25% FYM	25.98	26.66	34.86	35.23	60.15	62.90
N₃ - 75% RDF + 25% FYM	27.14	28.33	36.72	39.30	63.49	67.64
SE (d)	0.450	0.52	0.98	1.16	1.19	1.42
CD (P=0.05)	0.954	1.10	2.09	2.47	2.53	3.94
Moisture Conservation Practices (M)						
M₁ – Control	23.66	25.64	30.90	32.63	54.47	58.28
M₂ - Dust mulch	26.26	26.79	34.68	35.36	59.96	62.16
M₃ - Pinoxaden 5EC @ 50 g/ha + VAM @ 15 Kg/ha	27.60	27.77	37.78	38.63	65.41	66.40
SE (d)	0.58	0.6	1.28	1.45	1.22	1.47
CD (P=0.05)	1.18	1.38	2.59	2.94	2.47	2.98

Table.2 Effect of tillage preparatory, nutrient managements and moisture conservation practices on fresh weight (g) / plant of barley

Treatments	60DAS		90DAS		AT MATURITY DAS	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
Preparatory Tillage (T)						
T₁ - One cross ploughing with cultivator	108.97	116.83	149.42	158.02	26.03	27.94
T₂ - One ploughing with disc harrow + one cross ploughing with cultivator	110.80	118.47	149.64	160.02	26.45	28.29
T₃ - One ploughing by disc harrow + one pass with rotavator	114.03	122.02	154.02	164.82	27.23	29.08
SE (d)	1.62	1.89	1.80	1.98	0.43	0.41
CD (P=0.05)	3.44	4.01	3.82	4.20	0.91	0.87
Nutrient Management (N)						
N₁ - 100% RDF	105.07	112.70	144.12	152.22	25.10	26.91
N₂ - 75% RDF + 25% FYM	111.94	119.84	151.20	161.86	26.73	28.55
N₃ - 75% RDF + 25% FYM	116.80	124.78	157.76	168.76	27.88	29.84
SE (d)	1.62	1.89	1.80	1.98	0.43	0.41
CD (P=0.05)	3.44	4.01	3.82	4.20	0.91	0.87
Moisture Conservation Practices (M)						
M₁ – Control	101.88	109.42	137.62	148.02	24.32	26.17
M₂ - Dust mulch	113.15	121.48	155.04	164.08	27.02	28.95
M₃ - Pinoxaden 5EC @ 50 g/ha + VAM @ 15 Kg/ha	118.77	126.42	160.40	170.76	24.37	30.19
SE (d)	1.65	1.92	1.84	2.02	0.44	0.40
CD (P=0.05)	3.31	3.86	3.70	4.06	0.89	0.82

Table.3 Effect of tillage preparatory, nutrient managements and moisture conservation practices on dry weight (g) / plant of barley

Treatments	60DAS		90DAS		AT MATURITY DAS	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
Preparatory Tillage (T)						
T₁ - One cross ploughing with cultivator	8.41	8.59	16.31	16.74	18.28	18.75
T₂ - One ploughing with disc harrow + one cross ploughing with cultivator	8.52	8.73	16.30	16.96	18.27	18.97
T₃ - One ploughing by disc harrow + one pass with rotavato	8.79	9.03	17.04	17.51	19.09	19.62
SE (d)	0.12	0.15	0.28	0.35	0.33	0.33
CD (P=0.05)	0.25	0.32	0.59	0.74	0.70	0.70
Nutrient Management (N)						
N₁ - 100% RDF	8.09	8.27	15.68	16.11	17.57	18.05
N₂ - 75% RDF + 25% FYM	8.63	8.84	16.75	17.15	18.77	19.22
N₃ - 75% RDF + 25% FYM	8.99	9.24	17.22	17.92	19.29	20.08
SE (d)	0.12	0.15	0.28	0.35	0.33	0.33
CD (P=0.05)	0.25	0.32	0.59	0.74	0.70	0.70
Moisture Conservation Practices (M)						
M₁ – Control	7.87	8.04	15.26	15.67	17.10	17.56
M₂ - Dust mulch	8.71	8.96	16.66	17.38	18.66	19.47
M₃ - Pinoxaden 5EC @ 50 g/ha + VAM @ 15 Kg/ha	9.14	9.35	17.72	18.13	19.86	20.31
SE (d)	0.12	0.12	0.29	0.30	0.34	0.32
CD (P=0.05)	0.24	0.25	0.58	0.61	0.69	0.65

In conclusion the significantly highest grain yield (26.52 & 28.18 q/ha), straw yield (36.55 & 38.41 q/ha) and biological yield (62.34 & 66.60 q/ha) of barley was obtained with preparatory tillage operation of T₃) one ploughing with disc harrow + one pass with rotavator followed by T₂) one ploughing with disc harrow + one cross ploughing with cultivator of grain yield (25.74 & 27.17 q/ha), straw yield (34.25 & 36.06 q/ha) and biological yield (59.91 & 63.23 q/ha). Lowest grain yield (25.25 & 25.86 q/ha), straw yield (32.56 & 32.15 q/ha) and biological yield (57.60 & 57.01 q/ha) of barley was recorded in preparatory tillage operation given at T₁) one cross ploughing with cultivator during experimental year. However, some studies have reported that no tillage didn't increase the crop yield (Monneveux *et al.*, 2006; Masek and Novak, 2018). Baigys *et al.*, (2006). Maximum grain yield (27.14 & 28.33 q/ha), straw yield (36.30 & 39.72 q/ha) and biological yield (63.49 & 67.64 q/ha) of barley was obtained with significantly nutrient managements practices of N₃ 50% RDF + 50% FYM followed by N₂) 75% RDF + 25% FYM of grain yield (25.98 & 26.66 q/ha), straw yield (34.86 & 35.23 q/ha) and biological yield (60.15 & 62.90 q/ha). Minimum grain yield (24.39 & 25.21 q/ha), straw yield (31.78 & 32.65) and biological yield (56.19 & 57.30 q/ha) of barley was recorded in nutrient managements practices given at N₁) 100% RDF (60 Kg N + 30 Kg P + 30 Kg K /ha) recommended dose through chemical fertilizer during experimental year.

As compared to Sharma *et al.*, (2001), maximum yield of barley was obtained with significantly moisture conservation practices of T₃) pinoxaden 5EC @ 50 a.i. g/ha. (as post emergence) + VAM @ 15 Kg/ha of grain yield (27.60 & 27.77 q/ha), straw yield (37.78 & 38.63 q/ha) and biological yield (65.41 & 66.40 q/ha) compared to rest of M₂) dust mulch- grain

yield (26.26 & 26.79 q/ha), straw yield (34.68 & 35.36 q/ha) and biological yield (59.96 & 62.16 q/ha). Minimum grain yield, straw yield and biological yield of barley was recorded in moisture conservation practices given at M₁) control (23.66 & 25.64 q/ha), (30.90 & 32.63) and (54.74 & 58.28 q/ha) with cultivator during 2017-18 & 2018-19 respectively (Dinka *et al.*, 2018).

Preparatory tillage operation of barley given at T₃) one ploughing with disc harrow + one pass with rotavator, followed by practices T₂) one ploughing with disc harrow + one cross ploughing with cultivator increased fresh and dry weight plant⁻¹ at all stages (60DAS, 90DAS and maturity) of barley as compared to first year to second year, minimum fresh and dry weight plant⁻¹ of barley was obtained in preparatory tillage operation given at T₁) one cross ploughing with cultivator.

Under nutrient managements practices of barley given at N₃) 50% RDF (application through chemical fertilizer) + 50% FYM (farm yard manure), was increased fresh and dry weight plant⁻¹ at all stages (60DAS, 90DAS and maturity) of barley as compared to first year to second year.

Minimum fresh and dry weight plant⁻¹ of barley was obtained under nutrient managements practices given at N₁) 100% RDF during both the year of 2017-18 & 2018-19 respectively, and to conduct experiment was use of moisture conservation practices of barley given at T₃) pinoxaden 5EC @ 50 a.i. g/ha. (as post emergence) + VAM @ 15 Kg/ha, was maximum fresh and dry weight plant⁻¹ at all stages of barley during both year, minimum fresh and dry weight plant⁻¹ of barley was obtained in moisture conservation practices given at M₃) control during 2017-18 and 2018-19. As such as of Mohammad *et al.*, (2012).

Acknowledgement

The authors acknowledging major advisor, Dr. Sarvesh Kumar, Professor and also the authors are thankful to the junior Mr. Pradeep Kumar, Department for providing the required research facilities. Department of Soil Conservation & Water Management, C. S. Azad University of Agriculture & Technology, Kanpur,(U.P.) India 200 802 for his keen interest, valuable guidance, and constructive criticism throughout the pursuit of the present research and vital suggestion during preparation of this manuscript.

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How to cite this article:

Raghvendra Singh, Sarvesh Kumar Pradeep Kumar and Raj Kumar. 2021. Studies on Preparatory Tillage, Nutrient Managements and Moisture Conservation Practices as Response on Yield, Effective Fresh and Dry Weight of Barley Cultivation under Water Stress Condition. *Int.J.Curr.Microbiol.App.Sci*. 10(02): 686-695. doi: <https://doi.org/10.20546/ijcmas.2021.1002.082>