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QUALITY AND ECONOMIC OF FODDER OAT (*AVENA SATIVA* L.) AS INFLUNCED BY IRRIGATION AND NITROGEN UNDER SOUTHERN RAJASTHAN

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SUMMARY

An investigation was carried out during *rabi* 2013-14 at Instructional Farm, Rajasthan College of Agriculture, Udaipur with the object to evaluate the quality and economic of oat (*Avena sativa* L.) *var.* kent with irrigation and nitrogen levels. The experiment comprised combinations of four irrigations and three nitrogen levels. Thus, 12 treatments were evaluated in split-plot design with three replications. In the main plots, there were irrigations and nitrogen levels were kept under sub-plots. The results indicated that the application of five irrigations and 110 kg N/ha produced significantly higher nitrogen 314.49 and 309.94 kg/ha, crude protein 1965.59 and 1937.13 kg/ha, crude fibre 5271.72 and 5061.22 kg/ha, ether extract 308.28 and 303.25 kg/ha, mineral matter 1290.18 and 1277.18 kg/ha, nitrogen free extract 8759.00 and 8877.58 kg/ha and total digestible nutrient 12688.15 and 12595.72 kg/ha. In irrigation treatments higher gross return Rs. 83222/ha and net returns Rs. 69032.12/ha as well as B:C 3.28 were recorded with five irrigations. Gross return, net returns and B : C of oat increased with increasing level of nitrogen and highest values were recorded with 110 kg N/ha were Rs. 78477/ha, Rs. 60651.91/ha and 3.01, respectively.

Key words : Irrigation, nitrogen, oat, quality, economic

In Rajasthan, livestock population is around 54 million and the animal heads exceed human heads, which posses the problem of feed-fodder security for the state. Nearly 8 per cent of the milk and 40 of per cent wool production in the country is from Rajasthan state (Verma and Jeengar, 2015). Oat (*Avena sativa* L.), locally known as "jai", is an important non-legume, winter cereal crop, grown under irrigated conditions of northern and north-western regions of India because of its excellent growth characters, quick regrowth and economic source of dietary energy like other multicut fodders. Oat ranks sixth in the world cereal area, production and productivity, followed by wheat, maize, rice, barley and sorghum (Joshi *et al*., 2015 and Kumari *et al.*, 2018). It provides succulent and highly palatable fodder in two to three cuttings extending from december to february. Oat fodder can also be converted into hay or silage for feeding the animals during lean period (Malik *et al*., 2015). The perusal of literature shows that little work has been carried out in the past on irrigation management and nitrogen applications on quality of oat. Therefore, with this view the study was carried out. Water is a key input for sustainable crop production. Adequate and timely availability of irrigation water to crop is realized for higher and quality yield. Irrigation management for prevailing agro-climatic condition is major constraints for augmenting the crop productivity in *rabi* fodder. This warrants the need for adoption of irrigation levels which create a favourable soil moisture environment for maximizing yield by conserving moisture, proper utilization of applied nitrogen and improving crop growth and yield. Fertilizer has been considered as one of the most important input for growth and development of crop plants. The fertilizer requirement is being increasing every year and inspite of the increased output as chemical fertilizers, the gap between the demand and supply increasing. Among nutrients, nitrogen being an essential element play an important role in crop development, it is an important constituent of protoplasm and chlorophyll and is associated with the activity of living cells.

MATERIALS AND METHODS

The field experiment was carried out during *rabi* 2013-14 at Instructional Farm, Rajasthan College of Agriculture, MPUAT, Udaipur. The experimental site is situated at south-eastern part of Rajasthan at an altitude of 579.5 meter above mean sea level and at 24035' N latitude and 74042' longitude. The physico-chemical properties of experimental soil (Table 1). The

mean weekly weather data given in Fig. 1. The experiment consisted of 12 treatment combination, comprising four irrigation levels *viz.*, two-20 and 60 DAS, three-20, 40 and 60 DAS, four-20, 40, 60 and 80 DAS and five-20, 40, 60, 80 and 100 DAS and three nitrogen levels 70, 90 and 110 kg N/ha tested in split- plot design with three replications keeping irrigation in main and nitrogen in sub plots. Nitrogen in the form of urea was applied 1/3 at sowing time + 1/3 at 30 DAS + remaning dose after first cutting. Phosphorus fertilizer as common dose 30 P_2O_5 kg ha^{-1} was give in basal application through single super phosphate. The oat crop was sown on 26 Oct. 2013 as sole crop in 4-5 cm deep furrows opened at 20 cm apart using recommended seed rate was 100 kg/ha. The samples of oat were taken from all the treatments and sun-dried and then in the oven at 70oC. Oven dried samples were ground in a "Willey Mill" and passed through a screen containing 16 mesh cm^{-1} and then fodder quality constituents were estimated on dry weight basis. These constituents along with methods used for analysis are as nitrogen (Kjeldahl method), crude protein and mineral matter (A.O.A.C., 1970), ether extract and nitrogen free extract (Knowles and Watkins, 1960), crude fibre (Wright, 1939), and total digestible nutrients by using the digestible coefficient of crude protein, crude fibre, ether extract and nitrogen free extract (Ranjhan, 1991). The total quality nutrient productions (Two cuttings) were calculated as under :

$$\text{Quality nutrient production (kg/ha)} = \frac{\text{Quality nutrient content (\%)} \times \text{Dry matter yield (kg/ha)}}{100}$$

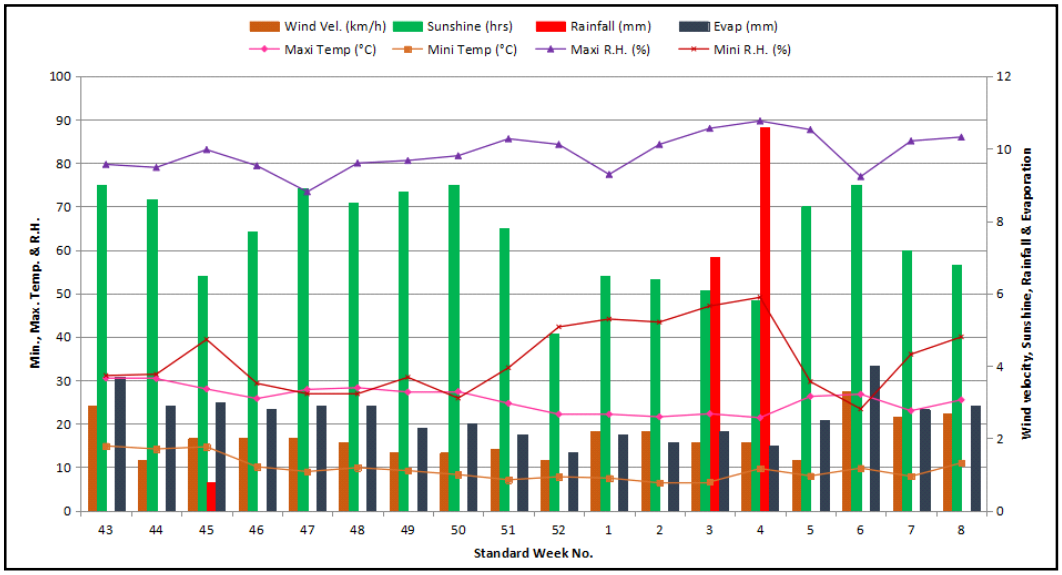

Fig. 1. Mean weekly weather meteorological parameters during crop growth period of Rabi 2013-14.

TABLE 1
Physico-chemical properties of experimental soils

Characteristics	Content	References and the method of analysis
Mechanical		
Sand (%)	38.3	International pipette method (Piper, 1950)
Silt (%)	28.4	
Clay (%)	33.3	
Textural class	Clay loam	Triangular diagram (Brady, 1983)
Physical		
Bulk density (Mg/m^3)	1.36	Core sampler method (Piper, 1950)
Particle density (Mg/m^3)	2.75	Black (1965)
Porosity (%)	49.15	Black (1965)
Chemical		
Organic carbon (%)	0.84	Walkely and Black (1947)
Available nitrogen (kg/ha)	295.3	Alkaline KMnO4 method (Subbiah and Asija, 1956)
Available phosphorus (kg/ha)	16.60	Olsen's method (Olsen et al., 1954)
Available potassium (kg/ha)	275.70	Flame photometer (Jackson, 1967)
pH (1 : 2)	8.0	pH meter (Piper, 1950)
Electrical conductivity (1 : 2) (dS/m at 25°C)	0.88	Conductivity bridge (Richards, 1968)
Soil moisture content (%)	11	Gravimetric method

The experimental data were statistically analyzed by Fisher's 'Analysis of Variance' technique (Fisher, 1950). To ascertain the most remunerative treatment, economics of different treatments were worked out in terms of net returns Rs/ha, which was computed by deducting cost of cultivation from income/ha fetched by the respective treatments. The B : C was also calculated treatment-wise to ascertain economic viability of the treatments by using following formula :

$$B : C = \frac{\text{Net returns (Rs./ha)}}{\text{Cost of cultivation (Rs./ha)}}$$

RESULTS AND DISCUSSION

A critical examination of data presented in (Table 2) shows that different irrigation and nitrogen treatments had significant affect on production of quality parameters *viz.*, nitrogen, crude protein, crude fibre, ether extract, mineral matter, nitrogen free extract and total digestible nutrients of fodder oat during experimental year. Five irrigations gave maximum nitrogen 314.49 kg/ha, crude protein 1965.59 kg/ha, crude fibre 5271.72 kg/ha, crude fat 308.28 kg/ha, mineral matter 1290.18 kg/ha, nitrogen free extract 8759.00 kg/ha and total digestible nutrient 12688.15 kg/ha production which were significantly higher by 29.04, 29.50, 27.09, 30.38, 26.92, 15.54 and 20.83 per cent over two irrigations, respectively. It was further observed that four irrigations were found significantly higher over two irrigations. However, five irrigations were statistically at par with four irrigations in crude fibre, crude fat and nitrogen free extract.

Similarly, with the application of 110 kg N/ha resulted in significantly higher nitrogen 309.94 kg/ha, crude protein 1937.13 kg/ha, crude fibre 5061.22 kg/ha, crude fat 303.25 kg/ha, mineral matter 1277.18 kg/ha, nitrogen free extract 8877.58 kg/ha and total digestible nutrient 12595.72 kg ha^{-1} productionover 70 but at par with 90 kg N/ha (Table 2). It was further observed that 90 kg N/ha was also found significantly higher by 15.89, 15.89, 9.99, 14.99, 14.45, 10.87 and 11.23 per cent, respectively over 70 kg N/ha.

The significant variation in production of quality parameters might be due to the fact that production is primarily a function of total biomass production (dry fodder yield) and their respective contents. Therefore, higher biomass production of fodder was recorded under five irrigation and 110 kg N/ha treatments, ultimately resulted in higher quality nutrients production of fodder in respective treatments. Similar finding was reported by Devi *et al.* (2010), Amandeep *et al.* (2010), Rana *et al.* (2013) and Malik *et al.* (2015).

In reference (Table 3) indicates that irrigation and nitrogen show significant affect on gross, net returns and B : C. It was observed that the maximum gross, net

TABLE 3
Effect of irrigation and nitrogen on treatments economics

Treatments	Gross returns (Rs./ha)	Net returns (Rs./ha)	B : C
Irrigation levels			
Two	55819	33457.77	1.78
Three	75670	56107.99	2.87
Four	78135	62552.89	3.09
Five	83222	69032.12	3.28
S.Em.±	1593	2091.86	0.10
C. D. (P=0.05)	4672	7238.80	0.36
Nitrogen levels (kg/ha)			
70	67757	49061.06	2.46
90	73399	56150.11	2.80
110	78477	60651.91	3.01
S. Em±	1839	1426.14	0.07
C. D. (P=0.05)	5394	4275.58	0.22

TABLE 2
Effect of irrigation and nitrogen on quality production (kg/ha) of fodder oat (mean of two cuttings)

Treatments	N	CP	CF	EE	MM	NFE	TDN
Irrigation levels							
Two	243.03	1518.95	4148.02	236.44	1016.54	7580.71	10500.90
Three	286.88	1792.98	4761.24	276.25	1171.37	8327.26	11798.80
Four	295.81	1848.84	4973.97	289.75	1212.15	8414.03	12084.43
Five	314.49	1965.59	5271.72	308.28	1290.18	8759.00	12688.15
S. Em±	6.608	41.300	112.690	6.415	29.168	190.592	268.341
C. D. (P=0.05)	19.381	121.129	330.507	18.813	85.547	558.987	787.018
Nitrogen levels (kg/ha)							
70	252.55	1578.44	4431.31	246.42	1044.75	7556.06	10750.77
90	292.67	1829.20	4873.67	283.36	1195.75	8377.11	11957.72
110	309.94	1937.13	5061.22	303.25	1277.18	8877.58	12595.72
S. Em±	7.630	47.689	130.123	7.407	33.680	220.077	309.854
C. D. (P=0.05)	22.379	139.868	381.637	21.724	98.781	645.462	908.770

N=Nitrogen, CP=Crude protein, CF=Crude fibre, EE=Ether extract, MM=Mineral matter, NFE=Nitrogen free extract and TDN= Total digestible nutrient.

returns and B:C were realized in five irrigations closely followed by four irrigations. The per cent increase in gross, net returns and B:C by five irrigations were 49.09, 106.33 and 84.27 per cent over two irrigations, respectively. However, the highest gross (Rs. 78477/ ha), net returns (Rs. 60651.91/ha) and B : C (3.01/ha) were recorded in 110 kg N ha^{-1}, which were significantly higher over 70 kg N/ha but statistically at par 90 kg N ha^{-1} except net returns. It is obvious because green and dry fodder yield increased with increasing irrigations and nitrogen levels in proportion to cost of cultivation. Each higher irrigation up to five irrigations and nitrogen dose up to 110 kg N/ha recorded significantly higher gross, net returns and benefit : cost than each lower irrigations and nitrogen dose during study. This can be ascribed to significantly higher green and dry fodder yield fewer than five irrigations and 110 kg N/ha. This clearly confirms to suitability of five irrigations and 110 kg N/ha based on economic feasibility apart from significantly higher green and dry fodder yield over lower irrigations and nitrogen levels under the Udaipur conditions. Similar results were also observed by Patel *et al*. (2011), Luikham *et al*. (2012), Jehangir *et al*. (2013) and Somashekar *et al*. (2015).

CONCLUSION

To enhance quality parameter productions *viz.*, nitrogen, crude protein, crude fibre, ether extract, mineral matter, nitrogen free extract and total digestible nutrient as well as monetary returns, of fodder oat should be treated with five irrigations with 110 kg N/ha.

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