Research Article

Potential of Single Cut Oat (*Avena Sativa*) Genotypes to Varied Levels of Nitrogen under Limited Irrigation Condition in Jharkhand

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Abstract

A field experiment was conducted under AICRP on Forage Crops with the collaboration of Agrostology unit of College of veterinary science and Animal Husbandry Ranchi (Jharkhand) to study the Potential of Single cut Oat (*Avena sativa*) genotypes to varied levels of nitrogen under limited irrigation condition in Jharkhand during *Rabi* season of two consecutive years 2012-13 and 2013-14. Growth, yield and quality of single cut oat genotypes influenced by Nitrogen levels. The maximum Leaf Area Index (LAI) (5.29), Green fodder Yield under JH-10-1(472.81 q/ha), while Dry fodder Yield under JH-10-2 (136.89 q/ha) and crude protein under Kent (9.41%) were recorded. Growth of entries increased with increased levels of nitrogen up-to 120 kg/ha. While, CP % recorded under some entries like JO-03-99, UPO-10-01 and national check Kent at 80 kg N/ha were significantly more over other levels of Nitrogen.

Keywords: Oat, Genotypes, crude protein and Green fodder yield.

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Introduction

India top in rank among ten milk producing countries in the world and produced 146.31 million tones of milk in 2014-15 (Ethical Indian 2016) not due to productivity of milch animal but due to contribution of very large population of livestock with low milking ability compared to other many western countries in the world. Malnutrition, under-nutrition or both, beside the low genetic potential of the animals is also prime factor for low productivity. The adequate supply of nutritive fodder and feed is a crucial factor impacting the productivity and performance of the animals [1]. The main reasons for low productivity is insufficient and low quality fodder and feed including grazing facilities [2]. The country is highly deficient in respect of availability of green fodder, dry fodder and concentrates. Future development and growth of livestock will certainly be highly associated with the scope of availability of fodder from cultivable land, forest, pastures and grazing lands. As among the different annual and perennial fodder Oat (*Avena sativa*) is most important annual cereal fodder suitable for *Rabi* season in Jharkhand. It has wide range of adoptability, quick growing habit and high yielding semi roughes as well as palatable and liked by different animal. Being succulent cereal it provides carbohydrate, fiber and mineral and slightly less fats and protein. Oat, single as well as multi-cut in nature is also highly responsive to fertilizers specially nitrogen, having good source of macro (N, P, K, Ca, Mg and S) as well as micro (Fe, Mn, Cu, B, Co, Cl, Na etc.) elements [3]. Under limited irrigation facility single cut oat has got priority over multi-cut. Different genotypes of single cut oat may perform variably and chances of suitability which guided by soil, climate and several other factors will never be uniform throughout the country. Soils of Jharkhand are generally acidic in nature which causes fixation of mainly P and Ca leading to poor availability of major and micro nutrients [4]. Irrigation is one of the limiting factors for growth and production, which are not in abundant. Generally farmers of Jharkhand are economically poor as well as less irrigation facility to spare it for Fodder oat. Thus, in order to assess the potential yield and quality of single –cut oat different genotypes at varied levels of nitrogen under limited irrigated condition was taken under investigation.

Materials and Methods

The present field investigation was carried out during *Rabi* 2012-13 and 2013-14 at the Agrostology field under collaboration with AICRP (Forage crops) scheme situated at CVSAH, campus Kanke under Birsa Agricultural

University, Ranchi. The soil of field was sandy loam in texture having sand (54.8%), silt (30.5%) & clay (15.7%) and water holding capacity (45.89 %), Bulk density (1.53 Mgm^{-3}) with pH (6.3), Organic carbon (3.99 g/kg). Further, the initial soil status was estimated as in terms of available nitrogen (268 kg/ha), available phosphorus (34.25 kg/ha) and available potassium (188.27 kg/ha). The experiment was laid out in Split- plot Design (SPD) with nine oat (SC) genotypes (JO-03-97, JO-03-99, SKO-170, SKO-188, OS-377, JHO-10-1, JHO-10-2, UPO-10-1 and UPO-10-2) with two national check OS-6 (NC), Kent (NC) and a zonal check JHO-99-2 (ZC) in main plot and three nitrogen levels (40, 80 and 120 kg/ha) under sub plot, which comprises of total thirty-three treatments combination. The oat was sown during last week of November during both the year at row spacing of 25 cm apart. The uniform recommended dose of Phosphorus 50 kg/ha and Potassium 25 kg/ha were applied in the form of Single super phosphate and Muriate of Potash while, Nitrogen was applied as per treatments through Urea. Full dose of Phosphate and Potash and half dose of nitrogen were applied at the time of sowing as basal dose and rest of the nitrogen was applied after 25 days of sowing. Observations were taken at 15 (for germination and population) days and growth, yield and quality parameter were taken at 50 % flowering stage (*i.e* at harvesting). The data of two year was pooled and analyzed statistically. The significance of treatment differences were evaluated by F-test as outlined by Cochran and Cox (1975) [5]. To evaluate the significant of difference between two treatment means, critical difference (CD) at 5 per cent level was worked out. For pooled analysis, error mean squares of individual year were tested for its homogeneity by 'Bartlett test' [6]. Data are arranged in group and represented in tabular form for discussion.

Climatologically description

The climate of the plateau region is different from other parts of Jharkhand with respect to temperature, rainfall, humidity and wind velocity. Variation in topography, soils, flora and fauna is also a distinguish characteristics of plateau region. The Climate of Jharkhand is classified as sub-humid. About 85 percent of the total rainfall concentrates during monsoon (June to September) and the rest 15 percent is received during rest of the months. During rainy season climate changes from humid and sub-humid and it is cold and arid during winter. The mean maximum temperature ranged between 19.3 to 32.4°C and 18.3 to 39.4°C while the minimum temperature ranged between 1.9 to 23.3° C and 2.5 to 23.8°C respectively during first and second year of experimentation.

Crop management

Desired plant population of oat was maintained by thinning of extra plants at 15 days after sowing to maintained optimum plant population. Hand weeding was done at the time of first appearance of a thick flush of weed (*i.e.* at 20 DAS) followed by hoeing at 35 DAS. Irrigation was applied as per the requirement of oat crop, at 20 and 40 DAS. During both the years of experimentation with different oat genotypes no incidence of insect, pest and disease in the plots. Harvesting of oat was done with a view to get maximum quality herbage production. A border row was left in length side and 0.25 m either side of width of each plot was removed and not taken into account leaving only net plot area. The harvesting of each net plot area was done separately from all plots and fresh weights were made. Plant samples were taken separately for other observations.

- **Number of tillers:** Number of tillers per square meter were counted from already marked 4 places in each plot at harvest and presented as average number of tillers per square meter.
- **Plant height (cm):** Height of five plants were recorded at marked places and measured in cm from base to tip of the top most leaves in each plot before harvesting. Thereafter, average height per plant was worked out for each treatment at each harvest.
- **Leaf area index (LAI):** Leaf area (cm^2) was measured by leaf area meter. All green leaves of tillers from 2 hills harvested for study of dry matter production was used for measuring leaf area. Leaf area obtained was divided by land area covered by two hills to get the leaf area index.

$$\text{LAI} = \frac{\text{Leaf Area (cm}^2\text{)}}{\text{Land Area (cm}^2\text{)}}$$

- **Leaf: stem ratio:** Randomly selected five hills were collected and leaves were separated from stem, tagged separately and weighed. Ratio of leaf and stem after taking mean value in green condition were calculated.

- **Green forage yield:** Harvesting of net plot area was done separately for each plots and the harvested material weighed and converted the yield in q/ ha.
- **Dry fodder yield (q/ha):** Two hills from the next to border rows were removed at harvest. All green leaves were detached and utilized to measure leaf area. Again after taking leaf area with leaf area meter added the detached leaves in previous sample. Then, weight 200 g green sample for drying firstly in sun, and after it again the samples were dried in hot air oven at 50 ± 5° C for 12 hours to obtain constant weight. Dry weight obtained from 200 g sample was converted into g/m^2 with the help of green forage weight collected from one meter row length and finely converted into Dry fodder yield in terms of q/ha.
- **Crude protein content and its yield:** Nitrogen content in green fodder at harvest was estimated from the collected sample using standard procedure of Kjeldahl digestion and distillation method. Crude protein content was determined by multiplying nitrogen content (%) in dried fodder sample with 6.25 (as protein contains 16% N). Crude protein yield was also worked out by with crude protein content and dry fodder yield and represented into q/ha.

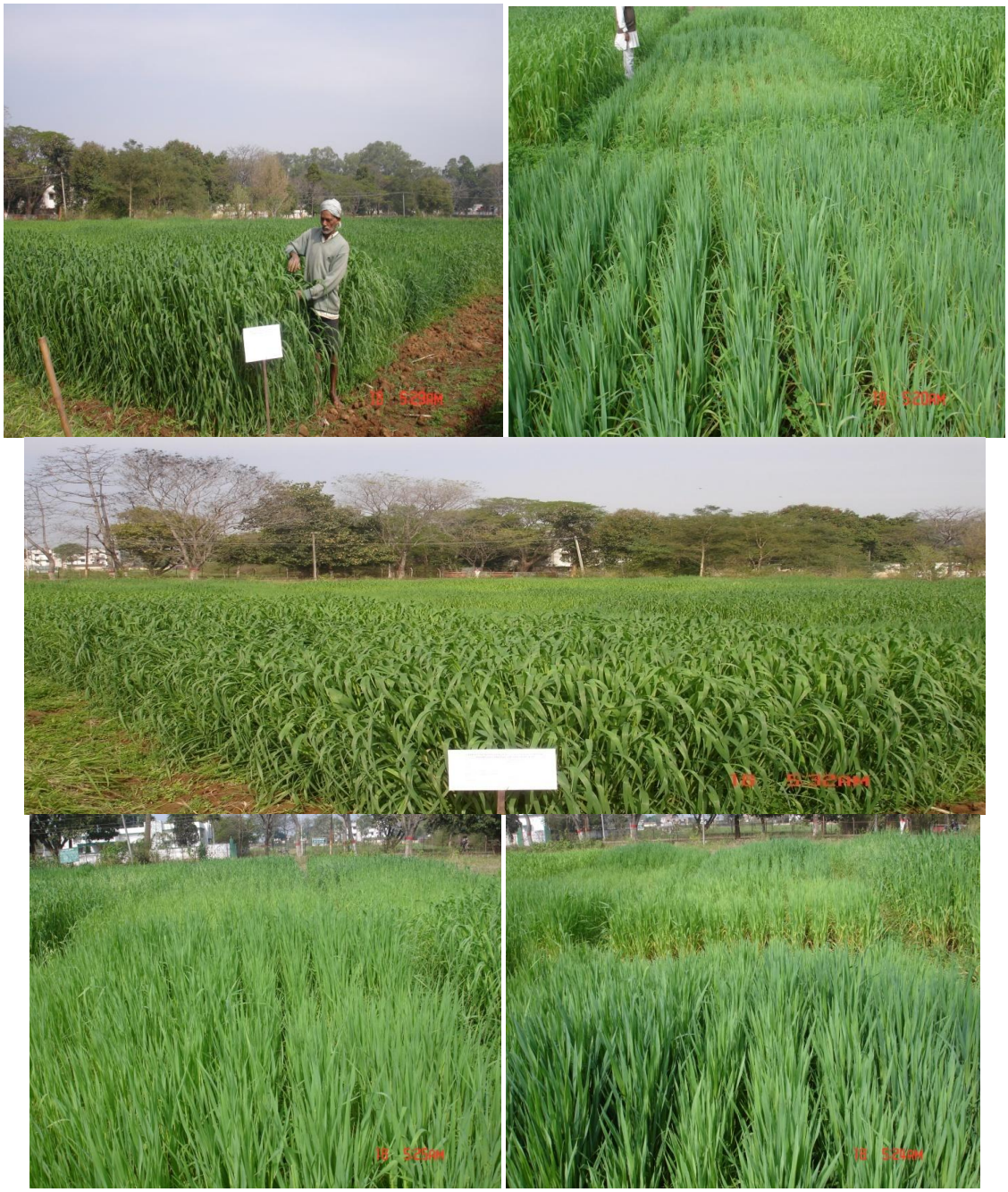

Figure 1 Field view of experimental field

Table 1 Physiochemical properties of the soil – experiment plot

Sl.No	Particulars	Value	Method used
I. Physical properties			
1	Sand (%)	54.8	Hydrometer method [7].
2	Silt (%)	30.5	
3	Clay (%)	15.7	
	Texture	Sandy loam	
II. Soil Moisture Constants			
1	Water holding capacity (%)	45.89	Keen Raczki modified [8].
2	Field capacity at 0.33 bar (%)	21.5	Pressure membrane plate apparatus [9].
3	Permanent wilting point at 15 bar (%)	11.36	Pressure membrane plate apparatus [9].
4	Bulk density (Mgm-3)	1.53	Core sampler [10].
III. Chemical properties			
1	Soil pH (1:2.5, soil: water ratio)	6.3	Glass electrode pH meter [11].
2	Organic Carbon (g/kg)	3.99	[12] as described in [13].
3	Available N (kg/ha)	268	Alkaline KMnO4 [14].
4	Available P2O5 (kg/ha)	34.28	Colorimetric estimation, Bray and Kurtz P1 [13].
5	Available K2O (kg/ha)	188.27	Flame Photometer [11].

Result and Discussion

Genotype response

The performance of Genotypes of tested single cut oat entries and three different check were compared and observed that, the entry JHO-10-1 produced more tillers /m^2 (411) more plant height (140cm), LAI (5.29), Green fodder yield (472.81 q/ha), Dry fodder yield (126.57 q/ha) which was at par with Zonal check JHO-99-2. However, maximum protein content was recorded under Kent (9.41%)which was at par with the entry JO-03-99 (9.37%), JHO-10-2 and UPO-10-1, similarly more crude protein yield was recorded under JHO-10-2(12.68 q/ha) which was significantly superior over all others tested oat entries. The highest green fodder yield (GFY) and dry fodder yield (DFY) recorded under genotype JHO-10-1. This is due to better growth as tillers/m length and more plant height, which directly related with the bulk herbage production. Further, protein content under Kent and JHO-10-2 were due to more leaf: stem ratio which indicates that leafy portion in green fodder production in Kent and JHO-10-2 was more than the other. Crude protein yield is the function of dry fodder yield and protein content, which was better in JHO-10-1 and OS-377. Thus, on the basis of GFY/DFY the entry JHO-10-1 and on the basis of protein yield OS-377 have got priority over the national checks as both the entries got nearly 20-24 % superiority over national check under the available limited irrigation resources.

Nitrogen response

The response of nitrogen in terms of number of tillers, plant height, L: S ratio, GFY and DFY were recorded up to 120 kg/ha. The maximum tillers/m length (416), plant length (144 cm), leaf: stem ratio (1.87) in green condition, Green forage yield (425.24 q/ha), Dry fodder yield (123.54q/ha), Crude protein content (11.25%) and Crude protein yield (11.25 q /ha) were recorded at nitrogen level 120 kg/ha. The stimulating effect of nitrogen on tillering might be due to the effect of nitrogen on cytokinin synthesis. More plant height and more LAI at higher nitrogen level was due to plenty supply of N along with P and K, which increased the protoplasmic constituents and accelerated the process of cell division and elongation [15-17]. Singh (1994) [18] observed an increase in plant height with the advancement of crop age and fertility levels mostly affected by nitrogen. Aklilu (2005) [19] also noted increase in plant height and LAI up to 160 kg N/ha.

Interaction

GFY, DFY**,** Crude protein content and crude protein yield were significantly influenced by interaction of Genotypes and levels of Nitrogen. (Graph 1-4). Increased levels of nitrogen increased the GFY, DFY and CPY continuously up-to 120 kg/ha. However, Crude protein also shown the similar trend except entries JO-03-99, UPO-10-01 and national

check Kent in which cp % at 80 kg/ha were higher than 120 kg/ha dose of nitrogen. This indicates the yield and quality have no similar response. According to [17] higher crude protein at higher levels of nitrogen was due to more availability of nitrogen and thereby its uptake by crop. Anay rawat and S.B. Agrawal (2010) [20] also reported that nitrogen content in plant tissue continuously decreased with the age of the crop and increased significantly with the increase in nutrient levels at first cut.

Table 2 Effect of nitrogen level on growth, yield and quality parameter of promising entries of single cut oat (two years pooled)

Treatments	Tillers /m^2 (at harvest)	Plant height (cm)	Leaf Area Index (LAI)	Leaf : stem ratio	Green fodder Yield (q/ha)	Dry fodder yield (q/ha)	Protein Content (CP) (%)	CP yield (q/ha)
Entries								
JO-03-97	413	131	4.48	1.83	337.11	98.56	8.56	8.49
JO-03-99	408	129	4.44	1.90	329.66	96.74	9.37	9.02
SKO-170	404	122	4.80	1.86	367.33	103.54	9.15	9.54
SKO-188	412	138	4.82	1.71	386.77	106.25	8.62	8.80
OS-377	406	125	5.18	1.86	448.14	136.24	9.19	12.62
UPO-10-1	403	130	4.78	1.91	350.41	101.47	9.40	9.63
UPO-10-2	411	129	5.08	1.83	409.64	117.25	8.65	10.18
JHO-10-1	411	140	5.29	1.75	472.81	126.57	8.79	10.96
JHO-10-2	405	124	5.18	1.82	449.04	136.89	9.24	12.68
OS-6 (NC)	411	126	5.10	1.82	411.27	121.24	8.6	10.53
Kent(NC)	405	128	4.99	1.90	402.19	114.27	9.41	10.74
JHO-99-2 (ZC)	410	136	5.28	1.71	471.87	127.85	8.66	10.99
S.Em ±	2.02	1.66	0.21	0.042	5.23	1.78	0.028	0.13
CD at 5%	5.96	4.89	0.62	0.124	15.45	5.27	0.082	0.40
N-level(Kg/ha)								
40	401	117	4.78	1.81	327.77	92.74	8.8	8.15
80	407	128	4.95	1.80	395.79	114.59	8.99	10.27
120	416	144	5.12	1.87	485.58	138.26	9.11	12.63
S.Em ±	1.45	0.8	0.06	0.016	2.81	1.11	0.006	0.09
CD at 5%	4.13	2.29	0.16	0.045	8.01	3.19	0.017	0.25
Interaction (TXN)	NS	NS	NS	NS	Sig.	Sig.	Sig.	Sig.

Table 3 Effect of nitrogen level on GFY, DFY, CP and CPY of single cut oat (two years pooled)

Entries	N- level(Kg/ha)											
	GFY(q/ha)			DFY(q/ha)			Crude Protein (%)			CPY(q/ha)		
	40	80	120	40	80	120	40	80	120	40	80	120
JO-03-97	282.41	325.45	403.27	73.45	105.27	117.25	8.29	8.49	8.91	6.08	8.93	10.44
JO-03-99	270.33	277	441.67	65.25	97.25	127.24	9.18	9.93	8.99	5.98	9.65	11.43
SKO-170	325.25	350.24	428.27	82.34	103.25	125.24	8.88	8.69	9.87	7.31	8.97	12.36
SKO-188	320.08	417.64	423	79.25	104.25	123.43	8.67	8.68	8.50	6.87	9.04	10.49
OS-377	311.25	477.54	552.24	115.24	128.24	165.25	8.93	8.73	9.92	10.29	11.19	16.39
UPO-10-1	267.66	325.24	459.37	85.35	101.24	119.25	9.27	10.03	9.08	7.91	10.15	10.82
UPO-10-2	355.25	380.66	493.25	104.25	112.2	135.25	8.37	8.57	9.02	8.72	9.61	12.19
JHO-10-1	420.25	465.29	533.35	93.25	125.21	160.25	8.76	8.76	8.58	8.16	10.96	13.74
JHO-10-2	335.25	478.25	535.47	104.25	139.35	165.23	8.97	8.77	9.97	9.35	12.22	16.47
OS-6 (NC)	325.24	406.28	502.25	102.25	118.25	145.24	8.33	8.53	8.95	8.51	10.08	12.99
Kent (NC)	329.81	337.94	538.83	95.25	113.25	134.25	9.23	9.98	9.04	8.795	11.30	12.13
JHO-99-2(ZC)	390.48	508.04	516.06	112.8	127.35	141.25	8.71	8.72	8.54	9.82	11.10	12.06
Between T at	SEm ±	CD at 5%		SEm ±	CD at 5%		SEm ±	CD at 5%		SEm ±	CD at 5%	
same or	9.06	28.06		3.09	11.14		0.048	0.061		0.238	0.89	
different N	9.83	27.43		3.74	10.45		0.034	0.095		0.291	0.833	

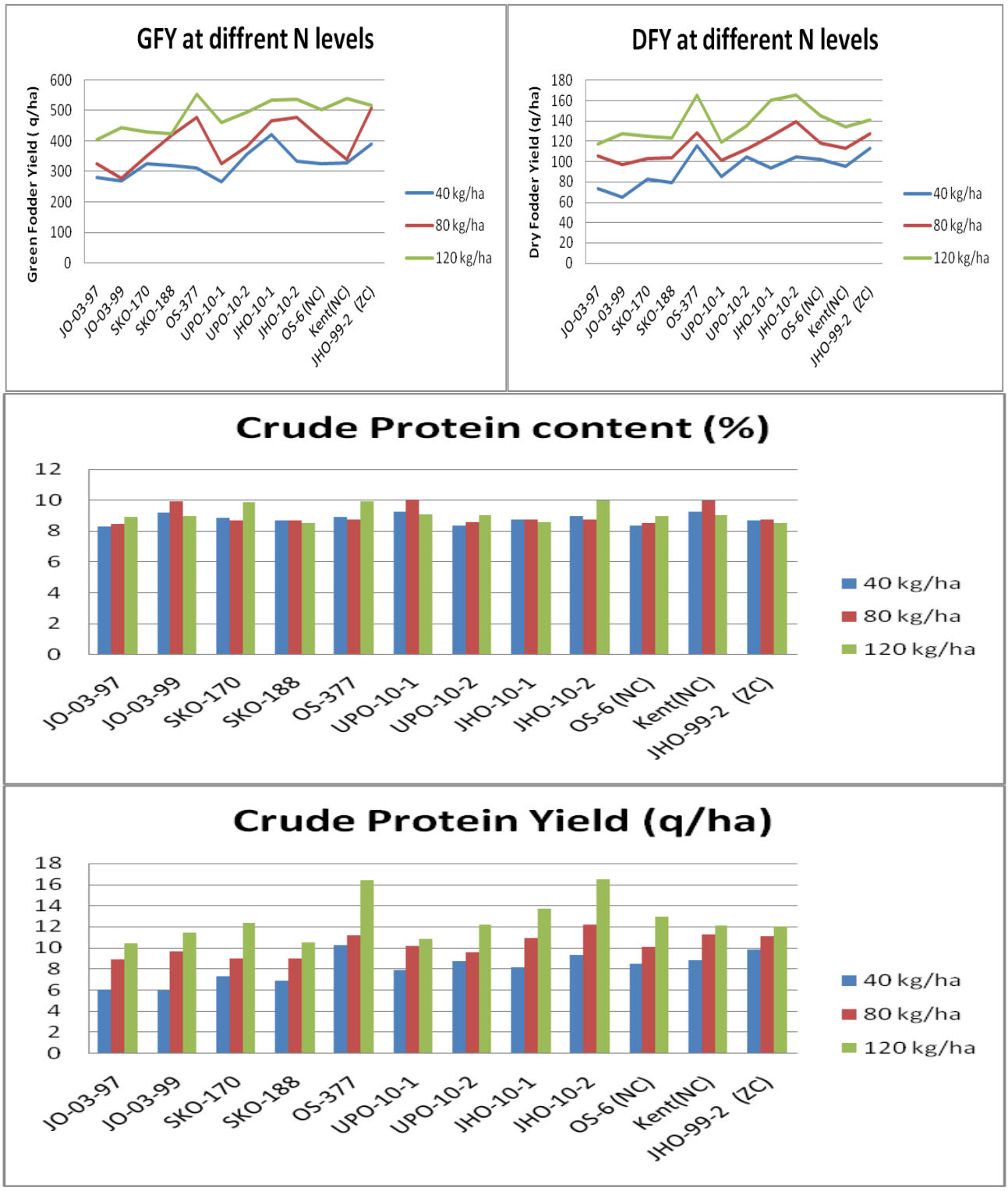

Figure 1 Graphical representation of GFY, DFY, CP and CPY of different single cut oat genotypes under different levels of nitrogen

Conclusion

Different genotypes of oat tested under this experimentation responded differently, however on the basis of green herbage produced genotype JHO-10-1 produced more quantitative and entries JHO-10-1and OS-377 recorded more qualitative produced over the others, as well as zonal check and national check. Thus, genotypes OS-377, JHO-10-1 and JHO-10-2 were recomendable.

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