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Nutritive capacity building in baby corn fodder through enhanced agronomic strategies

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ABSTRACT

The knowledge of type of fodder/forages fed to animal is very important to determine how to best meet the amount of nutrients required for animal maintenance and production. The following study was undertaken to boost nutritive value of baby corn fodder. The primary objective of the study was to assess the amenable agronomic traits, viz. cultivars, sources of urea and nitrogen levels in manipulating the quality factors of baby corn fodder, viz. dry matter content, crude protein, ether extract, ash content, acid detergent fibre, dry matter intake, dry matter digestibility, neutral detergent fibre, net energy requirement, total digestible nutrients, relative feed quality and relative feed value. The experiment was piloted during 2016–17 and 2017–18 at research farm of Agronomy section, ICAR-National Dairy Research Institute, Karnal, India. The treatments consisted of two varieties of baby corn (PHM-1 and HM-4), four-coated urea (Neem coated urea, zinc coated urea, sulphur coated urea and prilled urea) and four nitrogen levels (180, 150, 120 kg N/ha and control). All the quality parameters of fodder improved with progression in dose of fertilizer nitrogen. The highest values of said indices were statistically cogent with application of nitrogen at level 180 kg/ha whereas, DM, NDF and ADF showed a significant reduction at 180 kg N/ha compared to control (no fertilizer applied). The baby corn fodder fertilized with nitrogen dose 180 kg/ha showed better crude protein content, had less fibre, improved dry matter digestibility and intake, more digestible nutrients and higher feed value and quality.

Key words: Baby corn fodder quality, Coated urea, Nitrogen fertilization, Nutritional indices

The health and productivity of animals in our country is poor because the forages/fodder offered to animals are mostly of poor quality, which does not fulfil maintenance and production requirement of the animals leading to pitiable health of animals. Ruminants can eat a large quantity of feed of relatively low quality and poor digestibility; whole of energy and efforts of animal is spent in its digestion rather than development and maintenance leading to poor health and reduced productivity. The green fodder is cherished by animals and is known to have high nutritive value when compared to dry feed stalks. The walls of plant cells of green fodder are rich in fibre, high in digestibility and other quality constituents, providing good quality feed to animals. The best strategy to improve quality, the adoption of such a fodder crop that will make fodder production ruminative, is need of the hour. In last one and a half decade baby corn has received worldwide recognition of being high value crop in lieu of its high nutritive value and fodder quality. Baby corn fodder compared to other grasses has relatively high content of non-structural carbohydrates.

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As stated earlier, to surge fodder quality, enhancement in genetic base and improved agronomic practices are a prerequisite. In modern agriculture, nitrogen is the key nutrient in nutritive capacity building of fodder, enhancing yields and uplifting economy of farmer. It is structural component of proteins and during digestion protein is broken down into amino acids. These are then absorbed and used by animals for building body tissue, milk production and other vital developmental processes. Hence, efficient use of nitrogen in fodder production is crucial for increasing quality, environmental safety, and economic considerations (Campbell *et al.* 1995; Grant *et al.* 2002). Keeping all above studies and facts in mind, this study was conducted at the Research Farm of Agronomy section, National Dairy Research Institute, Karnal, Haryana to sustain higher productivity and produce high quality fodder balanced inorganic N need to be standardized for baby corn.

MATERIALS AND METHODS

The field experiments were conducted during the *Kharif* and *Rabi* season of 2016–2017 and 2017–2018 at the Research Farm of Agronomy section, National Dairy Research Institute, Karnal, Haryana; is situated at 29°–43´ N latitude and 76°–58´ E longitude with an altitude of 245 m amsl. The climate of the experimental site was mainly sub-tropical, semi-arid in nature endowed with hot and dry early summers followed by hot and humid monsoon and cold winter. The soil of the experimental field was sandy clay loam in texture, neutral in reaction, medium in organic carbon and available phosphorus, low in available nitrogen and high in potassium. The experiment was laid out in split-split plot design with three replications. The treatments consisted of two varieties of baby corn (PHM-1 and HM-4) in main-plot, four coated urea (NCU-Neem coated urea, ZCU-Zinc coated urea, SCU-Sulphur coated urea and PU-Prilled urea) in sub-plot and four nitrogen levels in sub-sub plot.

At arrival to the laboratory, samples were stored in hermetic plastic containers at 12±2°C and a relative humidity of 60±3% until analyses (less than 30 days in storage). The samples were ground using a Wiley mill fitted with a 0.50 mm screen and analyzed for moisture by oven-drying, ash with a muffle furnace and nitrogen (N) by Kjeldahl method as described by the AOAC International (2005). Crude protein content was calculated as N × 6.25. Ether extract (EE) was analysed by Soxhlet described by Boletiìn Oficial del Estado (1995). Crude fibre content was determined by sequential extraction with diluted acid and alkali (AOAC International, 2005) and the neutral detergent fibre (NDF) as described by van Soest *et al*. (1991). Data are presented on dry matter (DM) basis.

The dry matter intake (DMI), dry matter digestibility (DMD), net energy requirement (NL_1), total digestible nutrients (TDN) and relative feed quality (RFQ) were estimated according to the following equations adapted from Lithourgidis *et al*. (2006), Jahanzad *et al*. (2013). Whereas, relative feed value (RFV) was calculated by equation derived by Undersander *et al*. (2010). The formula used are—

$$\text{TDN (g/kg)} = -1.291 \times \text{ADF} + 101.35.$$

$$\text{DMI (g/kg)} = \frac{120}{\text{NSD}}$$

$$\text{DMD (g/kg)} = 88.9 - (0.779 \times \text{ADF})$$

$$\text{RFV (\%)} = \text{DMD} \times \text{DMI} \times 0.775$$

$$\text{RFQ \%} = \frac{(\text{DMI \% of BW}) \times (\text{TDN \% of DM})}{1.23}$$

$$NE_L \text{ (Mcal/kg)} = [1.044 - (0.0119 \times \text{ADF})] \times 2.205$$

where ADF, acid detergent fibre; BW, body weight; DM, dry matter; DMI, dry matter intake; DMD, dry matter digestibility; NDF, neutral detergent fibre; NL_1, net energy requirement; TDN, total digestible nutrients; RFQ, relative feed quality; RFV, relative feed value.

The data obtained from two consecutive years were pooled together and analysed statistically as per its procedure given by Cochran and Cox (1957). In case of significant results critical difference (CD at 5%) was calculated for testing the significance of difference between the treatments at 5% level of probability. The results presented in tables are based on two-year mean data pooled analysis.

RESULTS AND DISCUSSION

Dry matter content: The dry matter content (%) of babycorn cob, husk and fodder (Table 1) varied in cultivars and coated urea but did not produce any significant difference. The application of nitrogen levels witnessed progressive decrease in dry matter content of baby corn from control up to 180 kg/ha. The highest dry matter content of babycorn cob, and fodder was observed at control (7.4%), (7.7%) and (22.3%), respectively. It might be due to the fact that nitrogen adds to the succulence of plant, therefore increases the moisture content and in turn leads to reduction in dry matter content of plant. Whereas, the dry matter content of husk gradually decreased with increase in nitrogen levels but remained unsuccessful in producing statistically significant results. The dry matter content of baby corn plant decreased up to 180 kg N/ha.

Crude protein content: Similarly the crude protein content of baby corn cob and fodder also did not observe any statistically cogent results under two cultivars and different sources of urea. While interpreting the data in concern to effect of nitrogen levels on crude protein, successive increase in the level of nitrogen application from 0 to 180 kg/ha resulted in a significant increase in crude protein content of baby corn cob. In case of crude protein of husk, the two levels 180 kg N/ha and150 kg N/ha were found to be at par with each other (Table 1).

The crude protein content of maize fodder on dry matter basis increased significantly up to 180 kg N/ha over control. With increase in nitrogen level up to 180 kg/ha there was

Table 1. Effect of varieties, coated urea and N levels on Dry matter and Crude protein

Treatment	Dry matter (%)			Crude protein (%)		
	Baby corn	Husk	Fodder	Baby corn	Husk	Fodder
Varieties						
PHM 1	6.84	7.58	20.71	7.17	8.80	9.19
HM-4	6.83	7.50	20.74	7.17	8.87	9.01
SEm±	0.06	0.14	0.30	0.18	0.21	0.10
CD at 5%	NS	NS	NS	NS	NS	NS
Coated urea						
NCU	6.90	7.65	20.79	7.27	8.96	9.14
ZCU	6.81	7.57	20.66	7.19	8.84	9.05
SCU	6.81	7.47	20.73	7.19	8.87	9.21
PU	6.83	7.45	20.73	7.04	8.67	9.01
SEm±	0.09	0.20	0.32	0.19	0.20	0.17
CD at 5%	NS	NS	NS	NS	NS	NS
N levels						
0 kg/ha N	7.40	7.74	22.43	6.03	7.58	7.93
120 kg/ha N	6.91	7.62	20.95	7.00	8.70	8.90
150 kg/ha N	6.68	7.53	20.25	7.49	9.36	9.49
180 kg/ha N	6.35	7.27	19.27	8.17	9.71	10.08
SEm±	0.09	0.22	0.49	0.19	0.23	0.25
CD at 5%	0.19	NS	0.98	0.37	0.45	0.51

NCU, Neem coated urea; ZCU, Zinc coated urea; SCU, Sulphur coated urea; PU, Prilled urea.

increase in crude protein by 10%, 16% and 21% as compared to control treatment. Sheraz *et al.* (2012) reported that crude protein content showed significant and constant increase with increase in nitrogen dosage from 60 to 120 kg/ha. This increase in crude protein yield of maize was due to application of N fertilizer might be due to increased availability of nitrogen from the soil for protein synthesis.

Ether extract, ash content and organic matter content of baby corn fodder: There were no coherent differences among cultivars and coated urea (Table 2). While with accretion in nitrogen level, the baby corn quality parameters of fodder also showed positive effects. The application of nitrogen dose @ 180 kg/ha (2.32%) had shown significant increase in ether extract over control (1.82%) but was statistically at par with 150 and 120 kg N/ha. Similarly, the ash content, was found to be statistically compelling in level 180 kg N/ha (8.81%) over control. In concern with organic matter content reverse trend was recorded. The control treatment reported highest OM content (92.93%). The ether extract and ash content increased in baby corn fodder with increment in nitrogen rate from 0 to 180 kg/ha.

The ether extract is the representation of crude fat content whereas the ash content represents the mineral content of plants. The increase in the ether and ash content with increment in nitrogen dose might be due to the reason that higher doses may have allowed more diversion of nitrogen and other nutrients towards crop plant resulting in enhanced quality of fodder. Ullah *et al.* (2015) recorded increase in ash percentage with increase in nitrogen fertilizer doses.

Table 2. Effect of varieties, coated urea and N levels on quality parameters (% DM basis) of baby corn fodder

Treatment	Ether extract (%)	Ash content (%)	OM (%)	NDF (%)	ADF (%)	Hemi-celluloses (%)
Varieties						
PHM 1	2.12	7.92	92.08	62.37	34.59	27.79
HM-4	2.05	8.17	91.83	62.73	34.40	28.33
SEm±	0.029	0.061	0.06	0.87	0.35	0.61
CD at 5%	NS	NS	NS	NS	NS	NS
Coated urea						
NCU	2.13	2.07	2.10	62.40	34.66	27.73
ZCU	2.10	2.07	2.08	62.41	34.53	27.88
SCU	2.11	2.08	2.09	62.75	34.73	28.02
PU	2.07	2.05	2.06	62.66	34.06	28.60
SEm±	0.047	0.014	0.023	0.62	0.28	0.52
CD at 5%	NS	NS	NS	NS	NS	NS
N levels						
0 kg/ha N	1.75	1.89	1.82	63.90	36.21	27.69
120 kg/ha N	2.01	2.03	2.02	62.78	34.61	28.17
150 kg/ha N	2.24	2.11	2.18	62.30	34.00	28.29
180 kg/ha N	2.41	2.24	2.32	61.24	33.16	28.08
SEm±	0.038	0.014	0.019	0.62	0.40	0.59
CD at 5%	0.077	0.029	0.039	1.25	0.80	NS

NCU, Neem coated urea; ZCU, Zinc coated urea; SCU, Sulphur coated urea; PU, Prilled urea.

There was reduction in organic matter content with increase in levels of nitrogen fertilizer.

Neutral detergent fiber, acid detergent fiber and hemicelluloses content of baby corn fodder: NDF and ADF are fibrous parts of plant that increases with advancement in crop age. The higher the fibre content lower will be digestibility. Reduction in their percentage is found to increase feed intake and digestibility.

Scrutiny of the data regarding NDF, ADF and hemicelluloses (Table 2) content of baby corn fodder indicated that these parameters varied along cultivars and coated urea but did not produce any significant disparity. The application of nitrogen levels witnessed progressive decrease in dry matter content of baby corn from control up to 180 kg/ha. The significantly highest NDF and ADF content of baby corn fodder was observed at control (63.90%) and (36.21%), respectively. Whereas no significant results were reported in hemicelluloses content of fodder.

Total digestible nutrients, dry matter intake and dry matter digestibility of baby corn fodder: Total digestible nutrients (TDN), dry matter intake (DMI) and dry matter digestibility (DMD) of baby corn fodder obtained no statistically sententious differences among cultivars and coated urea. The statistics in concern to the effect of nitrogen levels on total digestible nutrients, dry matter intake and dry matter digestibility revealed that successive increase in the level of nitrogen application from control to 180 kg/ha resulted in a significant increase. Highest TDN (585.46 g/kg), DMI (19.64 g/kg) and DMD (28.08 g/kg) were obtained with application of nitrogen level 180 kg/ha over 120 kg N/ha and control. In case of DMI and DMD, 180 and 150 kg N/ha was found to be at par with each other (Table 3).

Voluntary intake of fodder is a primary factor for higher animal productivity. The higher dry matter intake (DMI) is related to better voluntary intake thereby higher nutrient intake while TDN refers to nutrients that are available for livestock growth and development processes. The total digestible nutrients, dry matter intake and dry matter digestibility witnessed successive increase in the level of nitrogen application from control to 180 kg/ha. Significantly highest TDN (585.46 g/kg), DMI (19.64 g/kg) and DMD (28.08 g/kg) were obtained with application of nitrogen @ 180 kg/ha. The TDN, DMI and DMD are negatively correlated with ADF content. Since ADF decreased with increase in N levels, thus higher TDN, DMI and DMD were observed in higher levels of nitrogen as expected. These results are in conformity with findings of Jahanzad *et al.* (2012)

Relative feed value; relative feed quality and net energy for lactation of baby corn fodder: The cultivars and coated urea did not produce any significant difference in relative feed value (RFV), relative feed quality (RFQ) and net energy for lactation (NE_1) of baby corn fodder (Table 3). The application of nitrogen levels witnessed progressive increase in RFV, RFQ and NE_1. The significantly highest

Table 3. Effect of varieties, coated urea and N levels on quality parameters of baby corn fodder

Treatment	TDN (g/kg)	DMI (g/kg)	DMD (g/kg)	RFV (%)	RFQ (%)	NL_1 (Mcal/kg)
Varieties						
PHM 1	567.00	19.28	619.58	92.58	88.89	1.39
HM-4	569.35	19.18	620.99	92.32	88.80	1.40
SEm±	4.56	0.27	2.75	1.62	1.82	0.01
CD at 5%	NS	NS	NS	NS	NS	NS
Coated urea						
NCU	571.38	560.58	565.98	92.43	88.68	1.39
ZCU	574.63	560.79	567.71	92.57	88.92	1.40
SCU	572.17	558.20	565.18	91.87	88.08	1.39
PU	577.57	570.07	573.82	92.92	89.71	1.41
SEm±	4.90	5.60	3.65	1.18	1.34	0.01
CD at 5%	NS	NS	NS	NS	NS	NS
N levels						
0 kg/ha N	555.71	536.37	546.04	88.59	83.59	1.35
120 kg/ha N	571.04	562.36	566.70	91.92	88.24	1.39
150 kg/ha N	580.40	568.61	574.50	93.30	90.09	1.41
180 kg/ha N	588.60	582.32	585.46	95.98	93.46	1.43
SEm±	7.26	5.98	5.12	1.23	1.45	0.01
CD at 5%	14.60	12.02	10.30	2.47	2.92	0.02

NCU, Neem coated urea; ZCU, Zinc coated urea; SCU, Sulphur coated urea; PU, Prilled urea.

Table 4. Effect of varieties, coated urea and N levels on crude protein, ash and ether extract yield of baby corn.

Treatment	Crude protein yield (kg/ha)	Ash yield (kg/ha)	Ether extract yield (kg/ha)
Varieties			
PHM 1	459.52	391.90	105.66
HM-4	542.73	491.57	123.41
SEm±	10.07	14.59	6.34
CD at 5%	43.34	62.77	NS
Coated urea			
NCU	538.78	477.87	123.47
ZCU	508.72	454.13	117.34
SCU	511.23	444.93	115.99
PU	445.78	390.00	101.35
SEm±	30.71	21.06	5.30
CD at 5%	66.90	45.88	11.55
N levels			
0 kg/ha N	238.61	208.84	54.04
120 kg/ha N	536.07	482.79	122.12
150 kg/ha N	607.11	529.75	138.43
180 kg/ha N	622.71	545.55	143.57
SEm±	26.08	21.11	5.97
CD at 5%	52.44	42.44	12.01

NCU, Neem coated urea; ZCU, Zinc coated urea; SCU, Sulphur coated urea; PU, Prilled urea.

relative feed value (95.9%), relative feed quality (93.46%) and net energy for lactation (1.43 Mcal/kg) of baby corn fodder was observed in nitrogen level 180 kg/ha over remaining three level. The nitrogen levels witnessed progressive increase in RFV, RFQ and NE_1. The RFV and RFQ index can be used to predict the intake and energy values of forages using DMD and DMI (Lithourgidis *et al.* 2006). As DMD and DMI values increased, the energy values also increased.

Crude protein, Ash and Ether extract yield: The crude protein yield of baby corn fodder was observed significantly higher in variety HM-4 (542.7 kg/ha) over PHM-1 (459.5 kg/ha) (Table 4). Similarly, the ash yield and ether extract yield was statistically cogent in HM-4 over PHM-1. The magnitude of increase was 20.3 and 16.8% respectively. Among sources of urea, NCU resulted in highest crude protein content (538.8 kg/ha). The three coated urea, viz. NCU, ZCU and SCU were at par with each other but significantly higher over PU. The NCU observed 20.8% increase over PU. Likewise ash yield and ether extract yield observed trend similar to crude protein yield. The magnitude of increase in NCU over PU in ash and ether extract yield was 22.5 and 21.82%, respectively. Nitrogenous fertilizers are subjected to various losses and its coating with materials helping in relatively slower release improves availability of nutrient and thus facilitates its uptake. This might be the reason behind higher yield in urea under various coatings.

The crude protein yield, ash yield and ether extract yield increased with increment in nitrogen doses. The level 180 kg/ha observed highest yield. The level 180 kg/ha and 150 kg/ha were found to be at par with each other but statistically cogent over 120 kg/ha and control. The magnitude of increase in level 180 kg/ha over control in crude protein, ash and ether extract yield was 160.9, 161.2 and 165.7%, respectively.

The enhancement in nutritive value of baby corn fodder depended on nitrogen fertilization. The baby corn fodder fertilized with nitrogen dose (180 kg/ha) showed better crude protein content, had less fibre, improved dry matter digestibility and intake, more digestible nutrients and higher feed value and quality.

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