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Comparative effect of different levels of NADEP manures on nutrients content and quality of different crops grown under certified organic farm

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Abstract
A field experiment was conducted at Certified Organic Farm of Navsari Agricultural University, Navsari during *rabi* 2017-18 and 2018-19 to study the effect of different levels of NADEP manures on nutrients content and quality of different crops. The experiment was conducted with five different crops (C1: sorghum, C2: green gram, C3: cabbage, C4: onion, C5: tomato) and three levels of NADEP manures (M1: 100% RDN, M2: 50% RDN, M3: 4t/ha) in FRBD with three replications. Results of the experiment revealed that the higher protein contain was observed in green gram followed by cabbage. Cabbage head and tomato fruit contain higher K, Zn and Cu, and onion bulb and cabbage head contain higher Fe and Mn. Total sugar, reducing and non-reducing content were higher in onion and green gram. Cabbage residues contain higher macro and micronutrient except Fe. However, Fe content was higher in onion residues. As far as manure levels are concerned, its effect on majority parameters of nutritional quality was non-significant except protein, N, Mn and Cu content in economic parts and residues parts of different crops. Treatment receiving higher amount of NADEP compost recorded higher content of these quality parameters as compared to lower levels.

Keywords: Organic farming, nutrients content, sugar and protein content

Introduction
India has achieved grand success in crop production in the latter half of the last century. Use of synthetic chemicals, highly responsive varieties and other technical support was credited for that but over reliant on chemicals and other agrochemical have pronounced impact on the quality of the produce as well as on the environment and ultimately on the human health. Thus, this conventional farming paved way to the organic or natural farming. The organic farming revolves around the four main principles *viz.* Health, Ecology, Fairness and Care. To comply these four principles of organic farming, there is need to revisit and reorient the different nutrient management practices in organic farming systems like as crop rotation, crop residues, bulky organic manures, green manures *etc.* as well as optimum utilization of farm resources is needed for making organic crop production feasible on harsh ground realities.
India produces 686 million tonnes gross crop residue biomass on annual basis, of which 234 million tonnes (34% of gross) are estimated as surplus (Hiloidhari *et al.*, 2014) [5]. On this base, per hectare biomass availability is 4.3t and 1.5t, respectively and per hectare nutrient availability from this biomass is 113 kg and 39 kg NPK, respectively. This indicates very low availability of nutrients for crop production in organic farming from available crop residues. Ponti *et al.* (2012) [8] compiled and analyzed a meta-dataset of 362 published organic–conventional comparative crop yields. The result of this analysis showed 20% reduction in crop yield under organic farming as compared to conventional ones. Therefore, the nutrient content and quality of crops is important criteria for identify crops and varieties suitable under organic farming particularly under nutrient stress condition.

Materials and Methods
The field experiment was conducted during *rabi* 2017-18 and 2018-19 at Certified Organic Farm of Navsari Agricultural University, Navsari, Gujarat. The experiment was conducted with five different crops (C1: sorghum, C2: green gram, C3: cabbage, C4: onion, C5: tomato) and three levels of NADEP manures (M1: 100% RDN, M2: 50% RDN, M3: 4t/ha) in FRBD with three replications. The soil of the experimental plot was medium in organic carbon, available N and P_2O_5 and high in available K_2O.

The pH (1:2.5 soil: water) values was near neutral in reaction and there was no problem of salinity. The NADEP manure was applied N equivalent basis. The RDN for sorghum, green gram, cabbage, onion and tomato was 80, 20, 200, 75 and 75 kg/ha, respectively. Biofertilizer *viz.*, *Azospirillum* and PSB for sorghum and *Rizobium* and PSB for green gram were treated with seeds @ 10 ml/kg seed. In case of tomato, onion and cabbage, seedlings roots were dip in the *Azotobacter* suspension (2-5 ml *Azotobacter*/Litre of water) before transplanting. Sorghum (GJ 38), green gram (CO-4), cabbage (Golden acre), onion (pilipati) and tomato (GT-2) were raised with recommended package of practices.

After harvest, fresh weight of each economic parts and total yield (grain yield of sorghum, seed yield of green gram, bulb yield of onion and head yield of cabbage and fruit yield of tomato) were recorded and expressed as t/ha. The plant samples were collected at maturity, dried in the air and then in an oven at 65±5º C to constant weight (AOAC, 1990) [1]. Plant samples were analysed for total N, P and K content by using standard procedure (Jackson, 1967) [6].

Total Fe, Mn, Zn and Cu were determined by atomic absorption spectrophotometer (Elwell and Gridley, 1967) [4]. Among the quality parameters, crude protein content in economic plant partswas determined by multiplying nitrogen per cent with 6.25 (Bhuiya and Chowdhary, 1974) [2]. Reducing sugars and total sugar were quantitatively estimated by phenol- sulphuric acid method (Sadasivam and Manickam, 1992) [9] and non-reducing sugar was obtained by subtracting reducing sugars from the amount of total sugars.

Results and Discussion

Quality parameters

Protein content

Green gram seed recorded higher protein content followed by cabbage head, tomato fruit, sorghum grain and onion bulb, manure treatment had significant effect on N content in economic parts of different crops fig 1.

Significantly higher protein content in economic parts was recorded under treatment M1 (100% RDN through NADEP compost) but it was remained at par with M2 during both the individual years.

Interactive effect of different crops and levels of NADEP manures for the accumulation of protein was found significant during pooled analysis and the combination C2M3 recorded higher protein content. Improvement in crude protein content under M3 level might be due to increased availability and uptake of nitrogen as this treatment received higher dose of NADEP manure. The results are in conformity with the finding of Degwale (2016) [3].

Sugar content

Total sugar content: Maximum total sugar content was observed in onion (6.15%) followed by green gram (5.15%). The lowest total sugar content was recorded in sorghum (1.52%) (Fig. 2). Furthermore, the application different levels of manure (M) and its interaction with crops (CxM) were failed to exert any significant effect on total sugar content in both the individual years as well as in pooled analysis.

Reducing sugar content: Crops were varied in their reducing sugar contents, higher reducing sugar content was recorded under onion (C4) followed by tomato (C5) during both the individual years and in pooled analysis (Fig 3).

The lowest reducing sugar content was recorded in sorghum (C1) during both years as well as pooled. With application of different levels of manure (M) and its interaction with crops (CxM) on total sugar content were non-significant in both the individual years as well as in pooled analysis (Fig 3).

Non-reducing sugar: Same trend were observed in non-reducing sugar content. In different crops, highest non-reducing sugar content was recorded in in onion (C4) and lower non-reducing sugar was recorded in sorghum (C1) during both the individual years and in pooled analysis. Whereas, effect of different levels of manure (M) and its interaction with crops (CxM) on total sugar content were non-significant in both the individual years as well as in pooled analysis (Fig 4).

Nutrients content in economic parts of different crops

Macronutrient content

Crops exhibited the significant differences for N content with respect to different treatments. The highest (3.24%) and mean lowest (0.94%) N content was noted in green gram (C2) and onion (C4), respectively. Higher protein content in green gram because of pulse crop. Additionally, manure treatment had significant effect on N content in economic parts of different crops. While, the lowest N content (1.69%) was recorded under 4 t/ha NADEP manure. The highest N content (1.77%) was recorded 100% RDN through NADEP manure.

Wide variation in P content among the green gram seed, cabbage head, tomato fruit, sorghum grain and onion bulb was observed (Table 1). Higher P content was recorded in cabbage head. Cabbage head (C3) recorded higher K content and green gram seed recorded lower K content.While, levels of manure as well as interaction effect of CxM was found not significant effect on P and K content in economic parts of different crops.

Micronutrient content

The content of micronutrients *viz.*, Fe, Mn, Zn and Cu were determined separately from economic plant parts and the results are presented in table 1. Onion bulb and cabbage head contain higher Fe and Mn, respectively. While, tomato fruit contain higher Zn and Cu. Amongst the different manures levels, significantly higher Mn and Cu content was recorded in level 100% RDN through NADEP compost (M1).

Nutrients content in residues parts of different crops

Macronutrient content

The higher N content (1.68%) was recorded in cabbage residues and the lowest N content (0.79%) was recorded in onion residues. Application of 100% RDN through NADEP compost (M1) recorded significantly higher N content as compared to lower levels of manure application (M2 and M3). However, M1 and M2 remained at par with each other with respect to N content in crops residues. Interaction effect of CxM on N content in crop residue was significant and higher N was recorded in C3M1 (Table 2). Higher P content (0.48%) and K content (1.86%) was recorded in cabbage residues.

Treatments involved in application of different levels of manures was failed to reach the level of significance with regards to P content and K content in residues in different crops.

Micronutrient content

The content of micronutrients *viz.*, Fe, Mn, Zn and Cu were determined separately from crop residue parts and the results are presented in (Table 2). Higher Fe content (301.6%) was recorded in onion residues. While, crop residue of cabbage

contain higher Mn (77.9%), Zn (58.5%) and Cu (18.0%) content. Crops (sorghum, green gram, cabbage, onion and tomato) are genetically varied in their nutrient content and quality parameters. Therefore, variation in nutrient content in different parts of crops might be observed. Amongst the different manures levels, significantly higher Mn and Cu content was recorded in level 100% RDN through NADEP compost (M1). It may be due to treatment receiving higher NADEP compost improve nutritional status in the root zone of the plants and subsequently higher nutrient absorption, translocation and accumulation of nutrient by plant (Patel, 2012) [7].

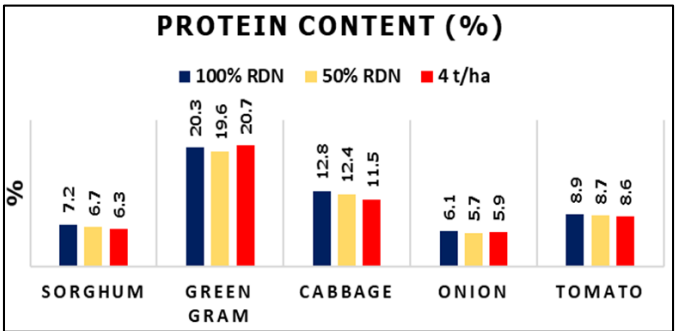

Fig 1: Effect of treatments on protein content in economic parts of different crops (Pooled over two years)

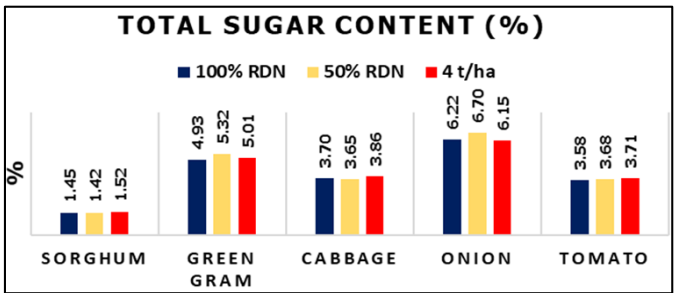

Fig 2: Effect of treatments on total sugar content in economic parts of different crops (Pooled over two years)

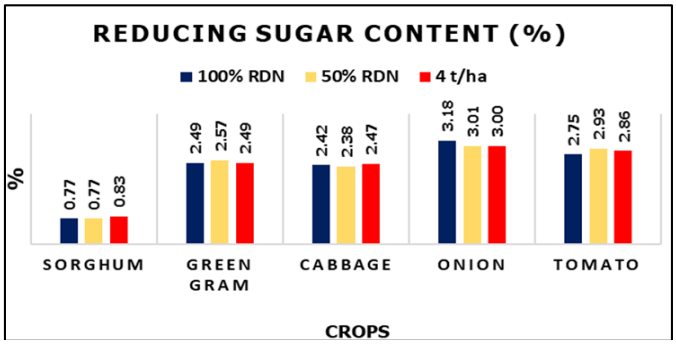

Fig 3: Effect of treatments on reducing sugar content in economic parts of different crops (Pooled over two years)

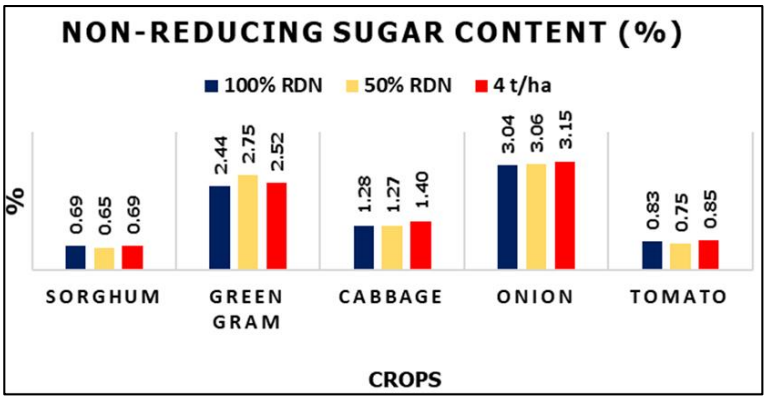

Fig 4: Effect of treatments on non-reducing sugar content in economic parts of different crops (Pooled over two years)

Table 1: Effect of different treatments on macro and micronutrients content in economic parts of different crops (Pooled over two years).

Treatments	Macronutrients (%)			Micronutrients (mg kg^{-1})			
	N	P	K	Fe	Mn	Zn	Cu
Different crops (C)							
C_1: Sorghum	1.08	0.36	0.94	62.6	26.2	17.8	3.5
C_2: Green gram	3.24	0.57	0.92	53.2	19.1	24.4	5.4
C_3: Cabbage	1.96	0.65	1.89	165.5	69.9	48.8	14.8
C_4: Onion	0.94	0.27	1.06	178.9	39.1	18.0	9.5
C_5: Tomato	1.40	0.44	1.19	144.8	29.7	54.0	15.8
SEm±	0.02	0.01	0.02	2.0	0.6	0.5	0.2
CD at 5%	0.06	0.03	0.05	5.6	1.7	1.3	0.5
Levels of manure (M)							
M_1: 100% RDN	1.77	0.47	1.22	124.0	39.0	33.3	10.4
M_2: 50% RDN	1.70	0.44	1.18	120.0	35.8	32.4	9.5
M_3: 4 t/ha	1.69	0.46	1.20	119.0	35.6	32.1	9.5
SEm±	0.02	0.01	0.01	1.5	0.5	0.4	0.1
CD at 5%	0.05	NS	NS	NS	1.3	NS	0.4
Interaction (C × M)							
SEm±							
CD at 5%	**	NS	NS	NS	NS	NS	NS
CV%	5.20	10.71	6.58	6.9	6.9	6.0	7.6

Table 2: Effect of different treatments on macro and micronutrients content in residues parts of different crops (Pooled over two years).

Treatments	Macronutrients (%)			Micronutrients (mg kg^{-1})			
	N	P	K	Fe	Mn	Zn	Cu
Different crops (C)							
C_1: Sorghum	0.82	0.24	1.05	150.1	20.8	18.2	5.0
C_2: Green gram	1.25	0.30	1.21	153.0	18.1	31.6	5.9
C_3: Cabbage	1.68	0.48	1.86	181.3	77.9	58.5	18.0
C_4: Onion	0.79	0.27	1.18	301.6	58.7	19.7	9.5
C_5: Tomato	1.23	0.37	1.02	131.5	74.5	49.2	15.2
SEm±	0.02	0.01	0.02	2.7	0.9	0.6	0.2
CD at 5%	0.05	0.02	0.05	7.7	2.6	1.8	0.5
Levels of manure (M)							
M_1: 100% RDN	1.20	0.34	1.30	186.5	52.2	36.3	11.2
M_2: 50% RDN	1.11	0.33	1.26	181.2	48.4	34.9	10.5
M_3: 4 t/ha	1.15	0.33	1.25	182.7	49.3	35.2	10.5
SEm±	0.01	0.01	0.01	2.1	0.7	0.5	0.2
CD at 5%	0.04	NS	NS	NS	2.0	NS	0.4
Interaction (C × M)							
SEm±							
CD at 5%	**	NS	NS	NS	NS	NS	NS
CV%	6.01	9.18	6.41	6.3	7.8	7.4	7.7

Conclusion

On the basis of present investigation, higher protein contain was observed green gram and cabbage. Cabbage head and tomato fruit contain higher K, Zn and Cu, and onion bulb and cabbage head contain higher Fe and Mn. Total sugar, reducing and non-reducing sugar content were higher in onion and green gram. As far as crop residues are concern, cabbage residues contain higher macro and micronutrient. However, Fe content was higher in onion residues. As far as manure levels are concerned, its effect on majority parameters of nutritional quality was non-significant except protein, N, Mn and Cu content in economic parts and residues parts of different crops. Treatment receiving higher amount of NADEP compost recorded higher content of these quality parameters as compared to treatment receiving lower level of NADEP compost.

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