

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.902.012>

Response of Popcorn to Organics and Fertilizer Levels on Growth Attributes and Yield Levels

V. E. Vishwanatha* and F. M. Duragannavar

Department of Agronomy, College of Agriculture, Dharwad 580005
University of Agricultural Sciences, Dharwad- 580005, Karnataka, India

*Corresponding author

ABSTRACT

A field experiment was conducted at the MARS, UAS, Dharwad to study the integrated nutrient management in popcorn (*Zea mays* var. *everata*) during *kharif* 2018. The experiment was laid out in split -plot design with three replications consisting of four organic levels as main plot (O₁: FYM @ 5 t ha⁻¹, O₂: FYM @ 7.5 t ha⁻¹, O₃: VC @ 1.25 t ha⁻¹ and O₄: VC @ 2.5 t ha⁻¹) and three fertilizer levels as sub plot (F₁: 75 % RDF, F₂: 100 % RDF and F₃: 125 % RDF) along with one absolute control. The experimental results revealed that, application of VC @ 2.5 t ha⁻¹ recorded significantly higher total dry matter accumulation (205.91 g plant⁻¹) at harvest and grain yield (3,541 kg ha⁻¹) and found at par with application of FYM @ 7.5 t ha⁻¹ (205.91 g plant⁻¹ and 3,494 kg ha⁻¹, respectively) compared to other organic levels. Among fertilizer levels, application of 125 % RDF recorded significantly higher total dry matter accumulation (207.20 g plant⁻¹) at harvest and grain yield (3,619 kg ha⁻¹) over other levels. Interaction effect indicated that application of VC @ 2.5 t ha⁻¹ + 125 % RDF recorded significantly higher total dry matter accumulation (219.20 g plant⁻¹) at harvest and grain yield (4,003 kg ha⁻¹) and found at par with application of FYM @ 7.5 t ha⁻¹ + 125 % RDF (216.63 g plant⁻¹ and 3,983 kg ha⁻¹, respectively). Absolute control recorded significantly lowest total dry matter accumulation (144 g plant⁻¹) and grain yield (1,378 kg ha⁻¹) compared to rest of the treatment combinations.

Keywords

FYM, VC,
Fertilizer, Organics,
RDF, Popcorn

Article Info

Accepted:
05 January 2020
Available Online:
10 February 2020

Introduction

Maize (*Zea mays* L.) is one of the important cereal crops stands first with respect to production in the world. In India, it ranks third after rice and wheat. Maize is known as “Queen of cereals” because of its high production potential and wider adaptability. It is not only represents a source of food, fodder and feed, but also gives rise to a range of by-

products including glucose, starch and corn oil. Popcorn is a speciality type of corn grown in small acreage around urban areas. The ability to pop is the unique characteristic that distinguishes from other types of corn. Popcorn has more of hard endosperm and starch granules are so embedded in tough elastic colloidal material that confines and restricts to steam pressure generated within the granule on heating until it reaches

explosive force (Weatherwax, 1922). The pops are a ready to eat products that could be used as snacks, break fast cereals, adjuncts in brewing. Popping improves the nutritional quality by reducing the antinutritional factors, increased protein, carbohydrates digestibility and provides dietary fibre in soluble form. The demand for the popcorn products increasing among the urban population. Out of total production of maize, 25 per cent of maize is consumed as a staple food in various forms including popcorn. In Karnataka, it is grown an area of about 15,000 hectare concentrated around urban areas such as Bangalore, Kolar, Chikkaballapur, Tumkur, Davangere and Belgaum due to better market outlet (Kanannavar, 2013).

There are several factors which are responsible for poor growth and yield of popcorn crop. One of the factor which is responsible for poor yield of crop is low fertility status of soils. At present, the only use of inorganic and organic fertilizer sources are also one of the main reasons for slow growth and low yield of maize. The organic sources maintain good soil aeration by improving soil structure and provide nutritious food to plant without any chemical residue. But organic manures are slow releasing, costly and reduce the overall yield of crop. The inorganic fertilizer are cheap, early releasing and require in very small amount as compare to organic fertilizer sources. But they degrade the soil, cause environmental and water pollution and serious health hazards in humans. Well decomposed FYM in addition to supplying plant nutrients also acts as binding material and improves the soil physical, chemical and biological properties. VC is rich in humus forming microbes and nitrogen fixers and drying of the VC does not deteriorate the microbial population. In recent years, the potential of FYM and VC to supply nutrients and enhance beneficial microbes for faster decomposition

is being recognized widely both in field crops and horticultural crops. Thus, to maintain sustained higher productivity levels of crops and sustaining soil health, integrated plant nutrient management system (IPNMS) has become important. The basic concept of IPNMS is the promotion and maintenance of soil fertility for sustaining crop productivity through optimizing all possible organic, inorganic and biological sources in an integrated manner, appropriate to each farming situation in its ecological, soil and economic possibilities. The principle aim of IPNMS is efficient and judicious use of all the major sources of plant nutrients in an integrated manner, so as to get maximum economic yield without any deleterious effect on physico-chemical and biological properties of the soil.

Materials and Methods

A field experiment was conducted during *kharif*2018 at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. Soil is medium deep black soil with neutral pH and medium in organic carbon with available nitrogen, phosphorus and potassium content of soil were 277, 35.22 and 366.55 kg ha⁻¹, respectively. American seed is a variety of popcorn and crop was sown by opening furrow using marker with a spacing of 60 cm × 20 cm. Seeds were treated with *Azospirillum* and PSB @ 20 g kg⁻¹ of seeds is common for all the treatments expect absolute control. The crop was sown on 28/06/2018 and followed by gap filling, thinning and harvesting at 12/10 /2018. The experiment was laid out in split -plot design with three replications consisting of four organic levels as main plot (O₁: Farm yard manure (FYM) @ 5 t ha⁻¹, O₂: FYM @ 7.5 t ha⁻¹, O₃ : Vermicompost(VC) @ 1.25 t ha⁻¹ and O₄:VC @ 2.5 t ha⁻¹) and three fertilizer levels as sub plot (F₁: 75 % RDF(recommended dose of fertilizer), F₂: 100 % RDF and F₃: 125 %

RDF) with one absolute control outside the design. RDF for popcorn is 125: 75: 37.5 kg N: P₂O₅: K₂O ha⁻¹ and FeSO₄ and ZnSO₄ @ 10 kg ha⁻¹ is common for all the treatments expect absolute control. The inorganic fertilizers were applied in the form of urea, diammonium phosphate and muriate of potash. The entire quantity of phosphorus, potash and 50 per cent of nitrogen (N) were applied at the time of sowing and remaining 50 per cent N applied at 30 DAS as top dressing. The calculated quantity of FYM was incorporated 15 days prior to sowing and VC was incorporated at the time of sowing as per treatments. The nitrogen content of FYM and VC was 0.4 and 1.2 per cent, respectively. Insect and diseases were managed as per zonal package of practice for Karnataka (Zone 8).

The biometric characters like plant height, number of leaves, leaf area, leaf area index, leaf area duration (LAD), total dry matter accumulation (TDMA), absolute growth rate (AGR), crop growth rate (CGR) were calculated for different plant growth stages. The formulae given by Sticker *et al.*, (1961) for leaf area, Watson (1952) for LAI, Radford (1967) for AGR and Watson (1956) for CGR were used for calculation.

Interpretation of the data was carried out in accordance with Gomez and Gomez (1984). The level of significance used in the 'F' and 't' test was p=0.05. The critical difference values were calculated wherever the 'F' test values were significant. The treatment means were compared by applying Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effect of organic manures on pop corn yield

The grain and stover yield of popcorn were significantly influenced by organics.

Application of VC @ 2.5 t ha⁻¹ recorded significantly higher grain and stover yield (3,541 kg ha⁻¹ and 69.8 q ha⁻¹, respectively) and found at par with application of FYM @ 7.5 t ha⁻¹ (3,494 kg ha⁻¹ and 69.8 q ha⁻¹, respectively). Application of VC @ 2.5 t ha⁻¹ recorded 1.3, 20.0 and 23.0 % increase in grain yield over the application of FYM @ 7.5 t ha⁻¹, FYM @ 5 t ha⁻¹ and VC @ 1.25 t ha⁻¹. The increased grain and stover yield was due to higher yield attributing characters. Increase in the grain yield and yield attributes was mainly due to higher growth in terms of plant height (32.7, 165.2 and 175.7 cm), number of leaves (5.17, 12.89 and 7.47), leaf area per plant (26.21, 68.41 and 39.18 dm² plant⁻¹), LAI (2.18, 5.70 and 3.27) at 40, 80 DAS and at harvest, LAD (157.70 and 179.32 days) at 40- 80 DAS and 80- harvest. The higher total dry matter accumulation (TDMA) per plant (at 40, 80 DAS and at harvest were 24.06, 158.16 and 205.91 g, respectively) resulted in higher AGR and CGR (3.35 g day⁻¹ and 27.93 g m⁻²day⁻¹) at 40- 80 DAS. Vermicompost is having higher nutrient content, faster decomposition rate, quick release of nutrients and enhancing the microbial population.

FYM encourage the biological activity, release of organic acids that might have mobilized the fixed soil nutrients to available form and release of nutrients throughout the crop growth period leading to better plant growth resulted in higher grain and stover yields. These results were conformity with the findings Barod *et al.*, (2012), Meena *et al.*, (2013) and Prasad *et al.*, (2018) in maize and Kalibhavi (2000) in sorghum.

Effect of fertilizer levels on pop corn yield

Application of 125 % RDF recorded significantly higher grain (3,619 kg ha⁻¹) and stover yield (71.7 q ha⁻¹) compared to application of 75 and 100 % RDF. The increase in grain yield of popcorn due to 125

% RDF over 75 and 100 % RDF and was to an extent of 23 % and 11 %, respectively. The increased grain and stover yield was due to higher yield attributing characters. The increase in yield was attributed to higher growth parameters *viz.*, plant height (32.9, 166.9 and 176.2 cm), number of leaves (5.18, 13.0 and 7.47), leaf area per plant (26.50, 67.37 and 38.55 dm² plant⁻¹), LAI (2.21, 5.61 and 3.21) at 40, 80 DAS and at harvest. The higher TDMA (24.73, 159.03 and 207.20 g plant⁻¹ at 40, 80 DAS and at harvest, respectively) was mainly due to higher AGR and CGR (3.36 g day⁻¹ and 27.97 g m⁻²day⁻¹) at 40- 80 DAS. Increased growth parameters might be attributed to higher availability of soil nutrients.

Nitrogen is an important structural component of chlorophyll which in turn forms the link between conversion of solar energy into chemical energy on which life depends. Phosphorous is an important constituent of nucleo proteins and accelerates high energy mediated biochemical reactions to provide a reduction potential in a sustainable form. It is required for root growth, elongation and proliferation and thus enabling the plant to extract water and nutrients from wider and deeper soil depths. It helps the plant to attain high growth which inturn leads to higher expression of yield attributing characters and ultimately yield. Potassium plays important role in enzyme activation, photosynthesis, protein and starch synthesis. It regulates stomatal activity, enhances the transport of sugars, water and nutrients. These results were conformity with Kanannavar (2013) and Hanjanatti(2017).

Higher amount of fertilizer has significant influence on effective translocation of accumulated photosynthates from source to sink and better development of grains. Similar results were also reported by the Bajirao (2006) and Basu (2013).

Interactions effect of organic and fertilizer levels on pop corn yields

Application of VC @ 2.5 t ha⁻¹ + 125 % RDF recorded significantly higher grain yield (4,003 kg ha⁻¹) and found at par with application of FYM @ 7.5 t ha⁻¹ + 125 % RDF (3,983 kg ha⁻¹). The increase in grain yield due to application of VC @ 2.5 t ha⁻¹ + 125 % RDF and FYM @ 7.5 t ha⁻¹ + 125 % RDF over the application of VC @ 1.25 t ha⁻¹ + 75 % RDF was to the tune of 56.0 % and 55.0 %, respectively. The increased grain and stover yield was due to higher yield attributing characters. The increase in grain and yield attributes was due to higher values of growth and growth parameters as evidenced by higher values of growth components *viz.*, plant height (35.0, 180.5 and 188.4 cm), number of leaves per plant (5.53, 13.53 and 7.93), leaf area (29.73, 74.88 and 43.18 dm² plant⁻¹), LAI (2.49, 6.24 and 3.60) at 40, 80 DAS and at harvest, LAD (174.24 and 196.77 days) at 40- 80 DAS and 80 DAS – harvest. The higher TDMA (27.24, 169.10 and 219.20 g plant⁻¹ at 40, 80 DAS and at harvest, respectively) resulted higher AGR and CGR (3.55 g day⁻¹ and 29.54 g m⁻²day⁻¹) at 40- 80 DAS. Higher grain yield was attributed to better and continuous optimum supply of nutrients throughout all the crop growth stages. Combination of organic and inorganic fertilizers helped to release nutrients at right time of crop requirement and increased translocation of photosynthates from source to sink for better development of grains. These findings were conformity with results of Elayarajan *et al.*, (2015), Jinjala *et al.*, (2016), Shah and Wani (2017) and Mahapatra *et al.*, (2018).

Significant variation in popping percentage, expansion volume and flake size of popcorn was not observed due to the interaction of organics and fertilizer levels.

Table.1(a) Growth parameters of popcorn as influenced by organic manures and fertilizer levels

Treatments	Plant height (cm)			Number of leaves			LA (dm ² plant ⁻¹)			LAI		
	40 DAS	80 DAS	Harvest-	40 DAS	80 DAS	Harvest	40 DAS	80 DAS	Harvest	40 DAS	80 DAS	Harvest
Organic levels (O)												
O₁: FYM @ 5 t ha⁻¹	28.6 ^b	153.0 ^b	160.0 ^c	4.84 ^{ab}	11.78 ^b	6.76 ^b	19.77 ^b	54.14 ^b	31.08 ^b	1.65 ^b	4.51 ^b	2.59 ^b
O₂: FYM @ 7.5 t ha⁻¹	31.9 ^a	161.1 ^a	170.8 ^b	5.04 ^a	12.87 ^a	7.43 ^a	26.03 ^a	66.33 ^a	38.36 ^a	2.17 ^a	5.53 ^a	3.20 ^a
O₃: Vermicompost @ 1.25 t ha⁻¹	28.3 ^b	142.3 ^b	154.0 ^c	4.60 ^b	11.62 ^b	6.44 ^b	17.73 ^b	53.62 ^b	29.76 ^b	1.48 ^b	4.47 ^b	2.48 ^b
O₄: Vermicompost @ 2.5 t ha⁻¹	32.7 ^a	165.2 ^a	175.7 ^a	5.17 ^a	12.89 ^a	7.47 ^a	26.21 ^a	68.41 ^a	39.18 ^{as}	2.18 ^a	5.70 ^a	3.27 ^a
S.Em. ±	1.0	3.3	1.3	0.09	0.21	0.09	1.09	1.79	1.18	0.09	0.14	0.09
Fertilizers levels (F)												
F₁: 75 % RDF	27.7 ^c	147.1 ^c	155.7 ^c	4.66 ^c	11.62 ^c	6.56 ^c	17.96 ^c	53.81 ^c	30.25 ^c	1.50 ^c	4.48 ^c	2.52 ^c
F₂: 100 % RDF	30.6 ^b	152.2 ^b	163.5 ^b	4.90 ^b	12.25 ^b	7.05 ^b	22.85 ^b	60.69 ^b	34.99 ^b	1.90 ^b	5.06 ^b	2.92 ^b
F₃: 125 % RDF	32.9 ^a	166.9 ^a	176.2 ^a	5.18 ^a	13.00 ^a	7.47 ^a	26.50 ^a	67.37 ^a	38.55 ^a	2.21 ^a	5.61 ^a	3.21 ^a
S.Em. ±	0.5	1.5	0.4	0.07	0.19	0.10	0.80	1.62	0.94	0.06	0.13	0.07
Interaction (O × F)												
O₁F₁: FYM @ 5 t ha⁻¹+75 % RDF	25.5 ^e	146.8 ^{cd}	152.5 ^e	4.67 ^{c-d}	11.07 ^{cd}	6.27 ^{ef}	15.03 ^{ef}	47.40 ^e	26.85 ^f	1.25 ^{ef}	3.95 ^e	2.24 ^f
O₁F₂: FYM @ 5 t ha⁻¹+100 % RDF	28.6 ^{de}	152.1 ^{bc}	160.7 ^d	4.80 ^{b-d}	11.87 ^{bc}	6.73 ^{c-e}	19.64 ^{c-e}	54.56 ^{c-e}	30.96 ^{d-f}	1.64 ^{c-e}	4.55 ^{c-e}	2.58 ^{d-f}
O₁F₃: FYM @ 5 t ha⁻¹+125 % RDF	31.8 ^{a-d}	160.2 ^b	166.9 ^c	5.07 ^{b-d}	12.40 ^{ab}	7.27 ^{a-c}	24.64 ^{bc}	60.45 ^{bc}	35.42 ^{b-d}	2.05 ^{a-c}	5.04 ^{bc}	2.95 ^{b-d}
O₂F₁: FYM @ 7.5 t ha⁻¹+ 75 % RDF	29.6 ^{cd}	147.9 ^{cd}	157.5 ^c	4.80 ^{b-d}	12.40 ^{ab}	7.10 ^{b-d}	21.42 ^{cd}	58.61 ^{b-d}	33.64 ^{c-e}	1.79 ^{cd}	4.88 ^{b-d}	2.80 ^{c-e}
O₂F₂: FYM @ 7.5 t ha⁻¹+ 100 % RDF	32.3 ^{a-c}	156.0 ^{bc}	166.7 ^b	5.07 ^{b-d}	12.67 ^{ab}	7.53 ^{ab}	26.93 ^{ab}	66.48 ^{ab}	39.45 ^{a-c}	2.24 ^{ab}	5.54 ^{ab}	3.29 ^{a-c}
O₂F₃: FYM @ 7.5 t ha⁻¹+ 125 % RDF	33.9 ^{ab}	179.3 ^a	188.3 ^a	5.27 ^{ab}	13.52 ^a	7.67 ^{ab}	29.67 ^a	73.90 ^a	41.99 ^a	2.48 ^a	6.16 ^a	3.50 ^a
O₃F₁: VC @ 1.25 t ha⁻¹+ 75 % RDF	25.2 ^e	138.5 ^d	146.4 ^e	4.33 ^e	10.60 ^d	5.87 ^f	13.86 ^f	48.19 ^{de}	26.72 ^f	1.16 ^f	4.02 ^{de}	2.23 ^f
O₃F₂: VC @ 1.25 t ha⁻¹+ 100 % RDF	28.5 ^{de}	140.7 ^d	154.2 ^d	4.60 ^{de}	11.73 ^{b-d}	6.47 ^{d-f}	17.38 ^{d-f}	52.43 ^{c-e}	28.96 ^{ef}	1.45 ^{d-f}	4.37 ^{c-e}	2.41 ^{ef}
O₃F₃: VC @ 1.25 t ha⁻¹+ 125 % RDF	31.1 ^{b-d}	147.7 ^{cd}	161.5 ^{b-c}	4.87 ^{b-d}	12.53 ^{ab}	7.00 ^{b-d}	21.95 ^{cd}	60.24 ^{bc}	33.60 ^{c-e}	1.83 ^{b-d}	5.02 ^{bc}	2.80 ^{c-e}
O₄F₁: VC @ 2.5 t ha⁻¹+ 75 % RDF	30.4 ^{b-d}	155.2 ^{bc}	166.6 ^c	4.83 ^{b-d}	12.40 ^{ab}	7.00 ^{b-d}	21.53 ^{cd}	61.04 ^{bc}	33.79 ^{c-e}	1.79 ^{cd}	5.09 ^{bc}	2.82 ^{c-e}
O₄F₂: VC @ 2.5 t ha⁻¹+ 100 % RDF	32.9 ^{a-c}	160.1 ^b	172.6 ^b	5.13 ^{a-c}	12.73 ^{ab}	7.47 ^{ab}	27.44 ^{ab}	69.31 ^{ab}	40.58 ^{ab}	2.29 ^a	5.78 ^{ab}	3.38 ^{ab}
O₄F₃: VC @ 2.5 t ha⁻¹+ 125 % RDF	35.0 ^a	180.5 ^a	188.4 ^a	5.53 ^a	13.53 ^a	7.93 ^a	29.75 ^a	74.88 ^a	43.18 ^a	2.49 ^a	6.24 ^a	3.60 ^a
S.Em. ±	1.3	4.1	1.5	0.15	0.37	0.20	1.71	3.20	1.94	0.14	0.26	0.16
Absolute control (C)												
C	18.8 ^f	106.0 ^e	113.4 ^f	3.67 ^f	7.80 ^e	6.07 ^g	8.67 ^g	25.00 ^g	17.84 ^g	0.72 ^g	2.08 ^f	1.49 ^g
S.Em. ±	1.3	3.8	2.1	0.23	0.38	0.24	1.66	3.15	1.97	0.13	0.26	0.16

DAS: Days after sowing, RDF: Recommended dose of fertilizer, 100 % RDF: 125: 75: 37.5 kg N: P₂O₅: K₂O ha⁻¹

Table.1(b) Growth parameters of popcorn as influenced by organic manures and fertilizer levels

Treatments	Popping percent (%)	Expansion volume (ml/g)	Flake size (ml)	Grain yield (kg ha ⁻¹)	Stover yield (q ha ⁻¹)
Organic levels (O)					
O ₁ : FYM @ 5 t ha ⁻¹	90.63 ^a	15.04 ^a	2.28 ^a	2949 ^b	65.4 ^b
O ₂ : FYM @ 7.5 t ha ⁻¹	90.68 ^a	15.42 ^a	2.37 ^a	3494 ^a	69.8 ^a
O ₃ : Vermicompost @ 1.25 t ha ⁻¹	90.27 ^a	14.98 ^a	2.31 ^a	2860 ^b	64.2 ^b
O ₄ : Vermicompost @ 2.5 t ha ⁻¹	90.74 ^a	15.33 ^a	2.36 ^a	3541 ^a	69.8 ^a
S.Em. ±	0.83	0.12	0.03	50	0.9
Fertilizers levels (F)					
F ₁ : 75 % RDF	90.44 ^a	15.00 ^a	2.29 ^a	2781 ^c	62.7 ^c
F ₂ : 100 % RDF	90.48 ^a	15.13 ^a	2.34 ^a	3233 ^b	67.5 ^b
F ₃ : 125 % RDF	90.83 ^a	15.45 ^a	2.36 ^a	3619 ^a	71.7 ^a
S.Em. ±	0.40	0.15	0.03	32	0.82
Interaction (O × F)					
O ₁ F ₁ : FYM @ 5 t ha ⁻¹ +75 % RDF	90.83 ^a	14.80 ^a	2.23 ^a	2683 ^{ef}	61.5 ^d
O ₁ F ₂ : FYM @ 5 t ha ⁻¹ +100 % RDF	90.37 ^a	15.00 ^a	2.31 ^a	2848 ^{de}	64.8 ^{cd}
O ₁ F ₃ : FYM @ 5 t ha ⁻¹ +125 % RDF	90.70 ^a	15.33 ^a	2.31 ^a	3314 ^c	69.8 ^{a-c}
O ₂ F ₁ : FYM @ 7.5 t ha ⁻¹ + 75 % RDF	90.33 ^a	15.20 ^a	2.34 ^a	2944 ^{cd}	65.0 ^{cd}
O ₂ F ₂ : FYM @ 7.5 t ha ⁻¹ + 100 % RDF	90.13 ^a	15.33 ^a	2.37 ^a	3553 ^b	70.8 ^{ab}
O ₂ F ₃ : FYM @ 7.5 t ha ⁻¹ + 125 % RDF	91.59 ^a	15.73 ^a	2.39 ^a	3983 ^a	73.5 ^{ab}
O ₃ F ₁ : VC @ 1.25 t ha ⁻¹ + 75 % RDF	90.16	14.80 ^a	2.27 ^a	2556 ^f	60.8 ^d
O ₃ F ₂ : VC @ 1.25 t ha ⁻¹ + 100 % RDF	90.27 ^a	14.93 ^a	2.32 ^a	2850 ^{de}	62.8 ^d
O ₃ F ₃ : VC @ 1.25 t ha ⁻¹ + 125 % RDF	90.39 ^a	15.20 ^a	2.34 ^a	3175 ^c	68.9 ^{bc}
O ₄ F ₁ : VC @ 2.5 t ha ⁻¹ + 75 % RDF	90.45 ^a	15.20 ^a	2.30 ^a	2942 ^d	63.3 ^d
O ₄ F ₂ : VC @ 2.5 t ha ⁻¹ + 100 % RDF	91.14 ^a	15.27 ^a	2.38 ^a	3680 ^b	71.4 ^{ab}
O ₄ F ₃ : VC @ 2.5 t ha ⁻¹ + 125 % RDF	90.63 ^a	15.53 ^a	2.41 ^a	4003 ^a	74.7 ^a
S.Em. ±	1.06	0.28	0.07 ^a	73	1.6
Absolute control (C)					
C	90.58 ^a	14.50 ^a	2.21 ^a	1378 ^g	54.2 ^e
S.Em. ±	1.01	0.31	0.07	69	1.6

Table.2 Quality parameters and yield of popcorn as influenced by organic manures and fertilizer levels

Treatments	LAD (days)		TDMA			AGR (g day ⁻¹)		CGR (g m ⁻² day ⁻¹)	
	40 -80 DAS	80 DAS-Harvest	40 DAS	80 DAS	Harvest	40 – 80 DAS	80 - Harvest	40 – 80 DAS	80 - Harvest
Organic levels (O)									
O ₁ : FYM @ 5 t ha ⁻¹	123.18 ^b	142.02 ^b	19.97 ^b	141.58 ^b	186.73 ^b	3.04 ^b	1.51 ^a	25.32 ^b	12.54 ^a
O ₂ : FYM @ 7.5 t ha ⁻¹	153.93 ^a	174.48 ^a	24.00 ^a	156.48 ^a	203.82 ^a	3.31 ^a	1.58 ^a	27.59 ^a	13.15 ^a
O ₃ : Vermicompost @ 1.25 t ha ⁻¹	118.92 ^b	138.96 ^b	19.40 ^b	138.98 ^b	183.90 ^b	2.99 ^b	1.50 ^a	24.90 ^b	12.47 ^a
O ₄ : Vermicompost @ 2.5 t ha ⁻¹	157.70 ^a	179.32 ^a	24.06 ^a	158.16 ^a	205.91 ^a	3.35 ^a	1.59	27.93 ^a	13.26 ^a
S.Em. ±	3.38	4.77	0.43	1.80	1.56	0.04	0.05	0.37	0.45
Fertilizers levels (F)									
F ₁ : 75 % RDF	119.62 ^c	140.10 ^c	19.15 ^c	139.56 ^c	184.16 ^c	3.01 ^c	1.49 ^a	25.08 ^c	12.38 ^a
F ₂ : 100 % RDF	139.23 ^b	159.47 ^b	21.69 ^b	147.80 ^b	193.91 ^b	3.15 ^b	1.54 ^a	26.26 ^b	12.80 ^a
F ₃ : 125 % RDF	156.45 ^a	176.53 ^a	24.73 ^a	159.03 ^a	207.20 ^a	3.36 ^a	1.61 ^a	27.97 ^a	13.38 ^a
S.Em. ±	3.31	4.14	0.49	1.34	0.97	3.01	0.05	0.31	0.47
Interaction (O × F)									
O ₁ F ₁ : FYM @ 5 t ha ⁻¹ +75 % RDF	104.05 ^f	123.75 ^e	17.56 ^g	134.21 ^{ef}	178.17 ^{ef}	2.92 ^{fg}	1.47 ^a	24.29 ^{ef}	12.21 ^a
O ₁ F ₂ : FYM @ 5 t ha ⁻¹ +100 % RDF	123.66 ^{d-f}	142.53 ^{de}	19.50 ^{e-g}	140.68 ^{de}	185.57 ^d	3.03 ^{d-g}	1.50 ^a	25.24 ^{c-f}	12.46 ^a
O ₁ F ₃ : FYM @ 5 t ha ⁻¹ +125 % RDF	141.81 ^{b-d}	159.79 ^{b-d}	22.86 ^{cd}	149.83 ^c	196.45 ^c	3.17 ^{c-e}	1.55 ^a	26.44 ^{b-d}	12.94 ^a
O ₂ F ₁ : FYM @ 7.5 t ha ⁻¹ + 75 % RDF	133.38 ^{de}	153.76 ^{cd}	21.29 ^{c-f}	147.13 ^{cd}	192.20 ^c	3.15 ^{c-f}	1.50 ^a	26.21 ^{b-e}	12.51 ^a
O ₂ F ₂ : FYM @ 7.5 t ha ⁻¹ + 100 % RDF	155.67 ^{a-c}	176.55 ^{a-c}	24.19 ^{bc}	155.30 ^{dc}	202.63 ^b	3.28 ^{bc}	1.58 ^a	27.30 ^{bc}	13.14 ^a
O ₂ F ₃ : FYM @ 7.5 t ha ⁻¹ + 125 % RDF	172.74 ^a	193.14 ^a	26.51 ^{ab}	167.00 ^a	216.63 ^a	3.51 ^{ab}	1.65 ^a	29.26 ^a	13.78 ^a
O ₃ F ₁ : VC @ 1.25 t ha ⁻¹ + 75 % RDF	103.42 ^f	124.85 ^e	17.03 ^g	130.21 ^f	173.91 ^f	2.83 ^g	1.46 ^a	23.57 ^f	12.14 ^a
O ₃ F ₂ : VC @ 1.25 t ha ⁻¹ + 100 % RDF	116.34 ^{ef}	135.63 ^{de}	18.85 ^{fg}	136.56 ^{ef}	181.27 ^{de}	2.94 ^{e-g}	1.49 ^a	24.51 ^{d-f}	12.41 ^a
O ₃ F ₃ : VC @ 1.25 t ha ⁻¹ + 125 % RDF	136.99 ^{c-e}	156.41 ^{b-d}	22.32 ^{c-e}	150.17 ^{cd}	196.53 ^c	3.20 ^{cd}	1.55 ^a	26.62 ^{bc}	12.87 ^a
O ₄ F ₁ : VC @ 2.5 t ha ⁻¹ + 75 % RDF	137.61 ^{c-e}	158.04 ^{b-d}	20.71 ^{d-f}	146.71 ^{cd}	192.37 ^c	3.15 ^{c-f}	1.52 ^a	26.24 ^{b-e}	12.68 ^a
O ₄ F ₂ : VC @ 2.5 t ha ⁻¹ + 100 % RDF	161.24 ^{ab}	183.15 ^{ab}	24.22 ^{bc}	158.68 ^b	206.17 ^b	3.36 ^{a-c}	1.58 ^a	28.00 ^{ab}	13.19 ^a
O ₄ F ₃ : VC @ 2.5 t ha ⁻¹ + 125 % RDF	174.24 ^a	196.77 ^a	27.24 ^a	169.10 ^a	219.20 ^a	3.55 ^a	1.67 ^a	29.54 ^a	13.91 ^a
S.Em. ±	6.43	8.28	0.85	2.84	2.23	0.07	0.10	0.62	0.90
Absolute control (C)									
C	65.91 ^g	89.02 ^f	12.36 ^h	110.60 ^g	144.00 ^f	2.45 ^h	1.12 ^b	20.43 ^g	9.31 ^b
S.Em. ±	6.21	7.96	0.84	2.74	2.16	0.07	0.10	0.6	0.89

RDF: Recommended dose of fertilizer , 100 % RDF: 125: 75: 37.5 kg N: P₂O₅: K₂O ha⁻¹

Quality parameters of popcorn was not appreciably affected due to nutrient management and dependent on genotypes, moisture content of kernel and maintenance of heat at the time of popping of kernels. These findings are in conformity with results of Weatherwax (1922) and Kanannavar (2013).

From this investigation, it can be concluded that integrated nutrient management in popcorn through application of VC @ 2.5 t ha⁻¹ + 125 % RDF or FYM @ 7.5 t ha⁻¹ + 125 % RDF was recorded higher growth and growth attributes and yield under rainfed situation in Northern transition tract of Karnataka.

References

- Bajirao, Z. N., 2006. Effect of integrated nutrient management on the performance of sweet corn. *Ph.D. (Agri.)*, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra (India).
- Barod, N. K., Dhar, S., and Kumar, A., 2012. Effect of nutrient sources and weed control methods on yield and economics of baby corn (*Zea mays* L.). *Indian J. Agron.*, 57 (1): 96-99.
- Basu, B. J., 2013. Response of popcorn (*Zea mays* var *everta*) to different fertilizer levels and plant densities in *kharif* season, *M. Sc. (Agri.) Thesis*, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra (India).
- Elayarajan, M., Sathya, S., and Arulmozhiselvan, K., 2015. Effect of inorganic fertilizers and organic manures on yield and nutrient uptake by maize hybrid under maize -sunflower cropping sequence in *Typic Haplustalf*. *Karnataka J. Agri. Sci.*, 28 (1): 29 -33.
- Gomez, K. A. and Gomez, A. A., 1984. *Statistical Procedures for Agricultural Research*, 2nd ed. John Wiley and sons. New York, p. 639.
- Hanjanatti, M., 2017. Studies on precision nitrogen management in maize. *M. Sc. (Agri.) Thesis*, Indian Agricultural Research Institute, New Delhi (India).
- Jinjala, V. R., Virdia, H. M., Saravaiya, N. N., and Raj, A. D., 2016. Effect of integrated nutrient management on baby corn (*Zea mays* L.). *Agri. Sci. Digest.*, 36 (4): 291-294.
- Kalibhavi, C. M., Kachapur, M. D., and Patil, R. H., 2001. Performance of *rabi* sorghum under integrated nutrient management system. *Indian J. Dryland Agric. Res & Dev.*, 16 (1): 45-50.
- Kanannavar, R., 2013. Response of popcorn (*Zea mays* var. *everta*) to nitrogen, phosphorus and potassium levels in northern transition zone of Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agril. Sci. Dharwad, Karnataka (India).
- Mahapatra, A., Nayak, A., and Bhol. R., 2018. Influence of integrated nutrient management on yield, uptake, soil fertility status and economics of baby corn (*Zea mays* L.). *Environment Ecology*, 36 (2): 535- 539.
- Malathesh, G. H., 2005. Nutrient substitution through organics in maize. *M. Sc. (Agri.) Thesis*, Univ. Agri. Sci. Dharwad, Karnataka (India).
- Meena, B. P., Kumar, A., Meena, S. R., Dhar, S., Rana, D. S., and Rana. K. S., 2013. Effect of sources and levels of nutrients on growth and yield behaviour of popcorn (*Zea mays* L.) and potato (*Solanum tuberosum*) sequence, *Indian J. Agron.*, 58 (4): 474- 479.
- Patra, P. S., and Biswas, S., 2009. Integrated nutrient management on growth, yield and economics of maize under terai region. *J. crop and weed.*, 5 (1): 130-133.
- Prasad, G., Rinwa, R. S., and Kumar, P., 2018. Growth and yield response in

- maize (*Zea mays* L.) to organic and inorganic nutrient sources under Haryana conditions. *Int. J. Pure App. Biosci.*, 6 (6): 259-265.
- Radford, P. J., 1967. Growth analysis formulae-their use and abuse. *Crop Sci.*, 7: 171-175.
- Ravi, N., Basavarajappa, R., Chandrashekar, C. P., Harlapur, S. I., Hosamani, M. H., and Manjunath, M. V., 2012. Effect of integrated nutrient management on growth and yield of quality protein maize. *Karnataka J. Agric. Sci.*, 25 (3): 395-396.
- Sahrawat, K. L., and Burford, J. R., 1982. Modification of alkaline permanganate method for assessing the availability of soil nitrogen in uplands soil. *Soil Sci.*, 133: 53-57.
- Shah, R. A., and Wani, B. A., 2017. Yield, nutrient uptake and soil fertility of maize (*Zea mays* L.) as influenced by varying nutrient management practices under temperate condition of Kashmir Valley, India, *Plant Archive.*, 17 (1): 75-78.
- Singh, M., and Srivastava, S., 1993. Sorghum grain moisture, its effect on popping quality. *J. Food Sci. Tech.*, 30: 296-297.
- Sparks., 1996. Methods of Soil Analysis Part – 3: Chemical Methods. *Soil Sci. Soc. America, USA.*
- Sticker, F. C., Wearden, S., and Paul, A. W., 1961. Leaf area determination in grain sorghum. *Agron. J.*, 53: 187-188.
- Tandon, H. L. S., 1998. *Methods of Analysis of Soils, Plant, Water and Fertilizers.* Fertilizer development and consultation organization, 31: 9-16.
- Watson, D. J., 1952. The dependence of net assimilation rate on leaf area index. *Ann. Bot.*, 22: 37.
- Watson, D. J., 1956. Comparative physiological studies on the growth of field crops variation in net assimilation of leaf area between species and varieties within and between years, *Ann. Biol.*, 11: 41-47.
- Weatherwax, P., 1922. Popping of corn. *Indian Academy Science Proceedings*, pp. 199-253.

How to cite this article:

Vishwanatha, V. E. and Duragannavar, F. M. 2020. Response of Popcorn to Organics and Fertilizer Levels on Growth Attributes and Yield Levels. *Int.J.Curr.Microbiol.App.Sci.* 9(02): 95-103. doi: <https://doi.org/10.20546/ijcmas.2020.902.012>