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Performance of cotton varieties in non conventional area (niche) under organic farming in Meghalaya

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Abstract : Field experiment was conducted at Research Farm of College of Agriculture (CAU-I), Kyrdemkulai, Meghalaya in *kharif* season of 2021-2022 to identify the potential of cotton varieties in non-conventional area. Experiment was conducted in randomized block design with four cotton varieties (CNA-1028, CNA-1032, Suraj and Roja). The result shoed that, the highest seed cotton yield of 342.2 kg/ha was reported in organic production system in acidic soil of Meghalaya for Suraj variety of cotton; while the yield across cotton varieties varies from 199 to 342 kg/ha. For vegetative growth parameter CNA-1028 was found superior; while for reproductive growth parameter, Suraj perform better indicating varied response of growth parameter in new environment and scope for their further investigation. The study of impact of sowing date, identifying the suitability of all four species of cotton and study of crop response to varied level and types of organic nutrition is needed to recognize adaptability of crop to new environment in production system.

Key words: Acidic soil, cotton, North East Hill region, Suraj

Cotton is first crop with transgenic varieties grown on 13.4 million ha area with 35.5 million bale (One bale = 70 kg) production in India in 2019-20 (Anonymous, 2021) with 65 per cent area under rainfed conditions. The crop cultivation zones for any crop is classified as conventional zone and non-conventional zone on the front of increasing adoption of crops in new area due to changing climatic condition as well as ever increasing need of provisional services due to population explosion and same is applicable for cotton. The conventional zone of cotton cultivation in India is classified in three zones *viz.*, north zone, central zone and south zone. Majority of these areas are growing transgenic cotton varieties and use of agrochemicals for pest and disease management as well as for crop nutrition is common in all three zones. This can be seen from fact that, out of four major species of cotton (*Gossypium arboreum*, *G. hirsutum*, *G. barbadense* and *G. herbaceum*) *G. hirsutum* occupies 90 per cent cultivated area (Venugopalan *et al.*, 2012) and among the total cotton area 93.3 pre cent is under genetically modified (GM) cotton (*Bt.* cotton) (2019-20); while out of total pesticide consumption in India, 50 per cent of the pesticides is consumed by cotton alone (Indira Devi *et al.*, 2017). With this extensive use of transgenic varieties and agrochemicals, area under organic cotton cultivation in conventional zones is less and will expected to be low productive due to pest and disease insurgence. In such case, intervention in the cotton cultivation in con-conventional zone such as North Eastern Hill region will serve as one of the best options.

The North East Hill region is composed of seven states with high variation in altitude, rainfall, vegetation, soil topography and relief. This variation leads to create different agricultural practices such as less use of agrochemicals due to their non performance in high rainfall and stiff sloppy soil, majority of area under organic farming with traditional crop varieties and practices, high enterprise diversity with farming system based agriculture, different variant of shifting cultivation and restriction on choice of crops due to rainfall and soil constraints. The

organic production system is common in NEH region and out of total area under organic farming (3.67 million ha out of which 2.299 million ha is cultivated area), 17.5 per cent was contributed by north east and north west Himalayan region (Khurana and Kumar, 2020; APEDA, 2021). This shows suitability of NEH region for organic cotton production. Besides suitability, very high variation in soil and climatic condition in space dimension need to be addresses by selecting the niche area for organic cotton cultivation in a state of or part of state to identify the production potential and constraints in production cycle.

Present study was conducted in Meghalaya and agro-climatic condition of state in explained by very high variation in monsoon season rainfall (1424.1 mm to 4375.9 mm), richness of soil in organic matter, soil physical constraints (erosion and shallow soil depth) soil chemical properties such as soil acidity, organic production system, increasing area under upland cultivation and need and significant of amendment use. In the state, on farm evaluation was conducted in Ri-Bhoi district (A district with least long term average seasonal and annual rainfall among all other district of state) (Anonymous, 2020) for identifying suitability of organic cotton in state. As evaluation of planting material is the first and foremost step for identifying the potential of crop in new region and in this context, the present study was conducted involving four cotton vatirties.

The field experiment was conducted at Research Farm of College of Agriculture (CAU-I), Kyrdemkulai, Meghalaya located at 25^0 74' N latitude, $91^0$81' E longitude and 700 meter above mean sea level during *kharif* season of 2021-2022. The objective of experiment is to identify the suitability of different cotton varieties in non-conventional area under organic production system. The climate of location is subtropical with average seasonal (June to September) and annual rainfall of 1424.1 mm and 2119.3 mm, respectively. The seasonal rainfall (28 May to 30 September) of 1328.9 mm with 73 rainy days and highest and lowest relative humidity of 92.5 per cent (27^{th} meteorological week) and 74.6 per cent (35^{th} meteorological week) were recorded during year of experiment (2021). The highest temperature of 34.4 ^{0}C and 33.4^{0}C was recorded in 41^{st} and 31^{st} meteorological week; while the rainfall during October month was 251.0 mm (first picking of cotton).

The experiment was executed in randomized block design involving four varieties *viz.*, CNA-1028, CNA-1032, Suraj and Roja replicated trice at three small blocks prepared for sowing of cotton. As crop and varieties were new to area, they are replicated at three different places located (10-15 m away from each other) in same field in order to increase their chances of survival, attend growth and express their yield ability to full potential. Besides place, two sowing date were tried (29 June-1 July, 2021 and 15^{th} to 16^{th}September, 2021) in order to escape duration of heavy rainfall and to identify additional sowing window of cotton which is generated due to increase in temperature in September and October month and as well as late season rainfall and post monsoon showers conducive for early season vegetative growth. The weakly maximum temperature in September and October month varies between 29.4 ^{0}C to 30.7 ^{0}C and 27.1 ^{0}C to 34.4 ^{0}C, respectively; while total rainfall received during September and October month is 293.5 mm and 251.0 mm, respectively. Cotton sown 29^{th} June to 1^{st} July, 2021 grown normally and sowing on 15^{th} to 16^{th}September, 2021 was failed (no germination) due to heavy rainfall after sowing (Rainfall of 20.2 mm, 54.0 mm, 37.4 mm and 40.0 mm on 17^{th}, 18^{th}, 19^{th} and 20^{th} September, 2021, respectively).

The field was ploughed once followed by shallow tillage and cleaning of weeds and sowing was done by dibbling 2-3 seeds at a spacing of 90 × 60 cm followed by gap filling twice (18-19 and 25-30 days after sowing). The crop was spot manured three times. At each time the

crop was manured @ 0.5 kg farm yard manure (FYM/plants which is about 9.2/ha; hence crop was manured @ 27.6 FYM/ha. The continuous rainfall leading to washing of manure and very low soil nutrient reserve are the reasons for higher rate of manure application. Weeding was done trice at 25, 40 and 55 DAS. The stagnated water was drained by earthing up around the plant and providing drains if needed; Moreover, as soil in light, water also drained out rapid from soil profile. The statistical significance among applied treatments were studied using the F-test and least significant difference (LSD) values (P = 0.05).

Effect of soil and weather on germination and stand establishment: The growth was slow during early stages due to continuous rainfall and cloudy conditions. The germination of crop is also affected due to rainfall which needs gap filling twice. The excessive water availability is expected to increase vegetative growth in cotton; while such observation was not recorded in our experiment. The low soil fertility, shallow soil depth and acidic soil reaction are the possible explanation for the same; while attempts taken to moderate these effects by applying higher manure and measure to reduce water logging (earthing up and drains in between rows) were not sufficient. Varies response of cotton to soil physical properties such as water holding capacity, drainage property, was reported by Ale *et al.*, (2021).

Effect of soil and weather on vegetative growth: The biometric observations (plant height and total number of branches) and yield attributes (number of flowers and number of square per plant) were measured at 110 days after sowing (DAS) and 140 DAS showed superior performance of CNA-1028 and CNA-1032. Plant height varies from 76 to 97 cm; while branches per plant were 13 to 16, respectively (Table 1). The CNA-1028 had significantly higher flowers than Suraj and other varieties remained on par in flowers/plants at 110 DAS; while all varieties were remain *on par* at 140 DAS. The number of flowers per plant dose not changes much at 110 and 140 DAS; while squares/plant increased by 1.5 to 11.3 at 140 DAS over 110 DAS; while in case of bolls/plant, the increase was 3.1 to 8.25 with highest increase in CNA-1028 and lowest increase in Suraj variety. Besides plant growth attributes, root growth is constrained mainly due to shallow soil depth and plant need to be stacked as well as earthing up (twice) to avoid their lodging due to heavy rainfall leading continuous loss of top soil and bending due to weight of bolls.

Effect of soil and weather on reproductive growth: The bolls/plant were highest in Suraj at 110 DAS and in CNA-1028 at 140 DAS; while all varieties were remained *on par* (Table 2). The lint yield and cotton seed yield/plant varies from 4.2 to 7.4 and 6.2 to 11.1, respectively with highest values for both characters in Suraj variety. Roja variety found inferior to Suraj in both lint and seed weight/plant; while CNA-1028 and CNA-1032 remained *on par* with Suraj in seed weight/plant and both had significantly lower lint weight per plant than Suraj. The order of varieties for their vegetative performance was CNA-1028 > CNA-1032 > Roja > Suraj; while same for reproductive

Table 1. Varietal variation in growth attributes of cotton

Varieties	Plant height (cm)		Total branches		Number of flowers		Number of square/plant	
	110 DAS	140 DAS	110 DAS	140 DAS	110 DAS	140 DAS	110 DAS	140 DAS
Suraj	46.0	76.1	8.0	13.2	1.26	2.16	5.1	6.6
Roja	59.4	81.4	11.2	14.4	2.30	2.88	10.1	10.0
CNA 1032	65.6	90.9	12.0	16.2	2.16	3.75	10.3	21.6
CNA 1028	60.9	97.7	11.3	16.3	2.50	3.95	9.8	15.9
LSD (P= 0.05)	17.7	17.5	3.25	2.71	0.80	2.14	2.38	13.14

Table 2. Varietal variation in yield attributes of cotton

Varieties	Number of bolls/plant		Weight of lint/plant (g/plant)	Wight of cotton seed/plant (g/plant)	Weight of seed cotton (g/plant)	Weight of seed cotton (kg/ha)
	110 DAS	140 DAS				
Suraj	6.10	9.2	7.42	11.06	18.48	342.2
Roja	5.15	7.6	4.56	6.21	10.77	199.4
CNA 1032	4.93	11.6	4.66	8.32	12.98	240.4
CNA 1028	5.25	13.5	4.19	8.47	12.66	234.4
LSD (*P*= 0.05)	1.98	7.68	2.46	4.66	7.03	130.3

character (yielding ability) was varied. For lint per plant the order of significance was Suraj > CNA-1032 > Roja > CNA-1028 and same for seed per plant was Suraj > CNA-1028> CNA-1032 > Roja. This indicates that, even an indeterminate crop, both vegetative and reproductive crop responses variably for weather conditions. Apart from this, the impact of sowing date, land configuration, soil amendment application and soil type (and organic matter) on crop growth and development expected to be different than what expected or observed in conventional area of cotton cultivation. The non-conventional area (ecology), capacity to stand the high rainfall, capacity to retain flowers up to their boll formations, capacity to tolerate soil reaction, opening of bolls and impact of red cotton bug incidence (only pest of cotton observed in the studied area) are the possible reasons for variable performance of varieties besides the genetic potential of crop varieties. Varies level of resistance of different varieties of cotton was reported by Ingole *et al.*, (2014) Besides that, being organic production system, the yield levels are expected to be low and non-extension of crop growing duration (beyond last week of December) are the other reasons for lower yield and similar results was reported by Forster *et al.* (2013). The crop didn't show any countable incidence of sucking pest even with high relative humidity in most of the cotton growing season.

REFERENCES

Ale, S., Himanshu, S.K., Mauget, S.A., Hudson, D., Goebel, T.S., Liu, B., Baumhardt, R.L., Bordovsky, J.P., Brauer, D.K., Lascano, R.J. and Gitz, D.C. III 2021. Simulated dryland cotton yield response to selected scenario factors associated with soil health. Front. Sustain. Food Syst. 4: 617509. doi: 10.3389/fsufs.2020.617509.

Anonymous, 2020. Observed rainfall variability and changes over Mghalaya state; Met Monograph No.: ESSO/IMD/HS/Rainfall Variability/17(2020)/41; available online on: imdpune.gov.in; Accessed on 17th February, 2021.

Anonymous, 2021. Economic survey 2020-21, Statistical Appendix, Department of Economic Affairs, Ministry of Finance, Government of India, p. 169; Available online on http://www.indiabudget.gov.in/economicsurvey/; Accessed on 11th March, 2022.

APEDA. 2021. Agricultural and processed food products export development authority, Ministry of Commerce and Industry, Government of India, Available online at http://apeda.gov.in/apedawebsite/organic/Organic_Products.htm#:~:text=As%20on%2031st%20March%202020,Hectare%20for%20wild%20harvest%20collection; Accessed on 5th March, 2022.

Forster, D., Andres, C., Verma, R., Zundel, C., Messmer, M.M. and Mader, P. 2013. Yield and economic performance of

organic and conventional cotton-based farming systems – results from a field trial in India. PLoS ONE **8(12):** e81039. doi:10.1371/journal.pone.0081039.

Indira Devi, P., Thomas, J. and Raju, R.K. 2017. Pesticide consumption in India: A spatiotemporal analysis. *Agricul. Econ. Res. Rev.* **30:** 163 – 72

Ingole, O.V., Patil, B.R. and Unhale, M.A. 2014. Screening of cotton cultivars/ genotypes against Bacterial blight caused by *Xanthomonas axonopodis pv. malvacearum* (Smith). *J. Cotton Res. Dev.* **28:** 332 – 33.

Khurana, A. and Kumar, V., 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi, 70. Available online at www.cseindia.org Accessed on 24th February, 2021

Venugopalan, M.V., Blaise, D. and Kranthi, S. 2012. Cotton. In: Textbook of Field Crops Production – Commercial Crops, Volume II (Prasad R. Eds.), Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, Krishi Anuasandhan Bhavan I, Pusa, New Delhi. pp. 305–344.

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