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Research Article

CLIMATE RESILIENT TECHNOLOGIES FOR SUSTAINABLE VEGETABLE PRODUCTION

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Abstract: Agriculture is subject to a variety of stresses, and the optimal yield is seldom obtained by stress. All crops grown under natural conditions are subjected to one stress or another. Climate change can have a positive and a negative effect on yield. A combination of higher average annual temperatures and stress on water (excess or deficit) can have significant consequences for tropical crop production. Vegetable crops are highly sensitive to climatic vagaries and sudden temperature rises as well as erratic precipitation at any stage of crop growth may affect normal development, flowering, pollination, fruit development and consequently decrease crop yield Dantewada's main climate change constraints are intermittent rainfall, light sandy soil, insect and disease problems in vegetable crops, etc. To mitigate the adverse effect of climate change on the production and quality of vegetable crops, resistance varieties of different vegetable crops, use of vegetable crops grown in drought conditions, agronomic practices such as resource management technologies, mulching, organic farming, carbon sequestration by crop systems provide a number of potential strategies to address impacts. Protected cultivation and post-harvest technologies can be effective strategies for addressing climate change challenges. Under the NICRA project Krishi Vigyan Kendra, Dantewada, climate sensitive technologies are being promoted in Dantewada district of Chhattisgarh.

Keywords: *NICRA, Climate resilient, Resistance varieties, Water use efficiency, Mulching*

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Introduction

Agriculture, particularly in India with nearly 60% rainfed area, has been a highly risky venture with vagaries of monsoon besides the interplay of other biotic and abiotic factors. Rainfall is predicted to be highly erratic with fewer rainy days but with greater intensity. Vegetable crops are highly sensitive to climatic vagaries and sudden temperature rises as well as erratic precipitation at any stage of crop growth may affect normal development, flowering, pollination, fruit development and consequently decrease crop yield [1]. There is positive correlation between meteorological parameters on the natural incidence of early blight disease and its severity in tomato [2]. Cultivated varieties of eggplant are susceptible to a wide array of biotic and abiotic stress conditions [3]. During 2010-11, the Indian Council for Agricultural Research (ICAR), New Delhi launched a major network project, the National Initiative on Climate Resilient Agriculture (NICRA), focusing on the process of developing district- contingency plans for all rural districts of the country, with the Central Research Institute for Dry Land Agriculture (CRIDA), Hyderabad as the nodal agency.

Material and Methods

The present study is conducted at Heeranar village under Dantewada district of Chhattisgarh. The geographical location of the village falls between 18° N-19' N to 81° 23' 035E and the elevation of the village is 404 m. The village Heeranar falls under Bastar plateau agro climatic zone of Chhattisgarh. The average rainfall of the village is 1159.3 mm. The soils mostly in this village are *Entisols* and Inceptisols. The major vegetable crops grown in this village are tomato, brinjal, cabbage, cauliflower, Colocasia, sweet potato etc. The major climate challenges encounters are prolonging dry spell like situation (drought). Erratic rainfall and early withdrawal of monsoon are the major constraint of the adopted village and due to that drought like situation occurs. There are three major topography of the land *i.e*. Upland, Midland and low land locally known as *Marhan, Tikra* and *Gabhar* respectively. Majority of area comes under upland in which farmers were grow vegetables, mid and early duration traditional rice. Five percent area of total cultivated area comes under Homestead garden/ Badi. Farmers used this Badi's for vegetable production and faces problems like water scarcity due to early withdrawal of monsoon during *Kharif* season under rainfed condition and some biotic factor like wilt in tomato, brinjal shoot and fruit borer in brinjal, Colocasia blight, diamond back moth in cabbage etc. are major constraints of the vegetable production. Changing of climate *i.e*. temperature, rainfall pattern etc. increases the incidence of biotic stresses. The environmentalist may argue that the use of those pesticides leads to global warming and the destruction of the ecosystems around farming areas. The effects of global warming affect pesticides, as pesticides lead to global warming. In view of the above challenges Krishi Vigyan Kendra, Dantewada demonstrated organic management strategies and varieties of resistance to major diseases and insects of vegetable crops, as well as humidity conservation practices and the implementation of drought tolerance of vegetable crops in the adopted village Heeranar under NICRA project.

Results and discussion

The following study of climate resilient agricultural intervention was adopted to upset the climatic extravaganzas in farmer's field during the period 2010- 2011 to 2016-2017.

Climate resilient technologies

Management practices for enhancing vegetable production

There are several management practices were used which provide economical

Table-1 *Impact of triple resistance hybrid Arka Rakshak of tomato*

Tomato cultivars	Disease intensity (%)	Fruits/plant (No.)	Yield (q/ha)	B:C Ratio
Arka Rakshak	0	47.99	354.64	3.47
Farmers practice (Hy. Laxmi)	17	29.79	212.13	2.07
% change over control	-	61.09	95.79	67.63

Table-2 *Impact of Organic management technique for control of Shoot and Fruit Borer of Brinjal*

Treatment	Marketable Yield (Q ha^{-1})	Infestation %	Marketable fruits/plant	Gross Return Rs/ha	Net Income Rs/ha	B:C Ratio
Farmer Practice (Ash)	171.6	26.83	16.53	171600	117446	3.16
Organic management	261.2	11.87	26.3	261200	191760	3.76
% change over control	52.21	55.67	59.1	52.21	63.27	18.99

Table-3 *Impact of Integrated management technique for control of DBM of Cabbage*

Treatment	MarketableYield (Q ha^{-1})	% change over control	Infestation%	% change overcontrol	Gross Return Rs/ha	Net Income Rs/ha	B:C Ratio
Farmer Practice (Chemical Control)	174.6	21.3	18.4	69.56	139680	90750	2.85
Integrated Management technique for DBM	211.8		5.6		169440	123880	3.71

Table-4 *Impact of mulching technique under open field condition on tomato*

Treatment	Yield (Qha^{-1})	% change	No. of Fruits/Plant	% change	Gross Return Rs/ha	Net Income Rs/ha	B:C Ratio
Farmer Practice (No use of Mulch under drip)	369.4	25	52.56	27.26	184700	124485	3.06
Mulching in Tomato under drip	461.9		66.89		230950	166140	3.56

yield under hot and wet condition. Some technologies were used to alleviate the production challenges.

Organic farming of Vegetable crops

Agriculture releases a significant amount of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) into the atmosphere amounting to around 10-12% of global anthropogenic greenhouse gas emissions annually, mostly methane from livestock rising, biomass burning and wet cultivation practices, and nitrous oxides from the use of synthetic fertilizers. If indirect contributions [4]. KVK, Dantewada demonstrated organic farming of agronomical and horticultural crops including disease and insect management practices.

Organic Manure and Bio-fertilizer

FYM, Vermicompost, *Jeevamrti, Beejamrit* are used as a source of nutrients for the crop as a supplement of chemical fertilizers. Some biofertilizer like PSB, *Azotobactor, Rhizobium, Mycorhhiza etc*. are also used as an organic fertilizer. As they play a nutritional stimulant and the therapeutic role in improving vegetable crop production, yield and quality. Vegetable crop inoculations with different bio-fertilizers have provided an encouraging response both in terms of growing yield, quality and soil fertility. The need to use biofertilizers emerged mainly because of a combination of two factors, i.e. although chemical fertilizers improve soil fertility, crop productivity and growth, but increased / intensive use of chemical fertilizers has created serious concern about soil texture, soil fertility and other environmental issues, the use of biofertilizers is both economical and environmentally friendly.

Organic Disease Management in vegetable crops

Triple resistance hybrid Arka Rakshak of tomato along with *Trichoderma viride*

Bacterial wilt, Fusarium wilt, Mosaic and leaf curl in tomato is very serious problem in the district and adopted village as well. Yield reduction up to 75 % was observed due to these diseases. Looking to the above problem Arka Rakshak hybrid tomato along with *Trichoderma viride* was demonstrated in the adopted village and adjoining villages. The success of Arka Rakshak is due not only to its high-yielding nature but also to its resistance to three tomato diseases: leaf curl virus, bacterial wilt and early blight. Resistance to triple diseases will reduce the cost of cultivating fungicides and pesticides by 10 to 15 percent in terms of savings [5]. *Trichoderma viride* is one of the fungi that controls wilt of Tomato successfully, when applied as seed and soil treatment. Seed treatment with *Trichoderma viride* @ 5gm/kg seed and soil treatment along with FYM @ 250 kg/ha + 2.5 kg *Trichoderma viride* were applied.

Organic management technique for control of Shoot and Fruit Borer of Brinjal

Brinjal is second most important crop of the district and mostly cultivated under Badi situation as well as field condition. Heavy incidence of Shoot and Fruit Borer of Brinjal reduces the yield of brinjal as well as interest of farmers on brinjal cultivation. Organic management technique of brinjal shoot and fruit borer were taken from IIVR and demonstrated in the farmer's field under NICRA and adjoining villages. Under these technology, oblong /small fruited variety (Arka Keshav), Pheromone trap at 10m distance from 20 DAT, Clipping of infested shoot with larvae inside at weekly interval from 15 DAT until the shoot infestation is lost, Intercropping of Brinjal (2 rows) with Coriander (one row), In case of severe infestation need based foliar spray of Neem Seed Kernal Extract (4%) were taken.

Integrated management technique for control of Diamond Back Moth (DBM) of Cabbage

Yield loss up to 35% was observed due to Diamond Back Moth (DBM) of Cabbage. Farmers used insecticide for the control of DBM but year after year the dose of insecticide increases due change in climate and insect develops resistant against the insecticide. Looking to the above problem KVK demonstrated integrated management technique with minimum use of insecticide for control of Diamond Back Moth (DBM) of Cabbage. The technology involves growing paired mustard rows with every 25 cabbage rows (The first row of mustard should be sown 15 days before and second 25 days after cabbage transplanting), Dichlorovos 0.1% is sprayed at weekly interval on the mustard to kill the trapped DBM larvae, if required neem seed kernel extract (5%) may be sprayed to control the larvae population in main crop. As a whole, the technology offers a sustainable and safe means of controlling one of Asia's most persistent insect pests. By reducing or eliminating the use of pesticides, the technology lessens the risks to human health and helps protect the environment.

Water-saving irrigation management

Mulching technique under open field condition on tomato

This study investigated the combined effects of drip irrigation and mulches on yield and economic return of tomato. Drip irrigation system and mulching, a relatively new technology in Dantewada district, is being used for growing vegetable crops. It has created interest because of decreased water requirement and possible increase in production [6]. The use of polyethylene mulch in vegetable production was reported to control weed incidence, reduce nutrient loss and improve hydrothermal regimes of soils [7]. Tomato hybrids Arka Rakshak were demonstrated under drip irrigation with plastic mulch.

Application of research: Climate resilient innovations are promising instruments to protect an agricultural system from climate change. Among the technologies demonstrated in the NICRA villages, there was a distinction between improved soil and land management practices, water management practices, crop development interventions and crop system interventions.

Research Category: Climate resilient technology, Water use efficiency

Abbreviations: DBM: Diamond Back Moth
NICRA: National Initiative on Climate Resilient Agriculture
ICAR: Indian Council for Agricultural Research
CRIDA: Central Research Institute for Dry Land Agriculture

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Study area / Sample Collection: NICRA Project, ICAR-Krishi Vigyan Kendra, Dantewada, 449441

Cultivar / Variety / Breed name: Tomato, Brinjal, Cabbage

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number:

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