EFFECT OF DIFFERENT ORGANIC WEED MANAGEMENT PRACTICES ON GROWTH AND YIELD OF SWEET CORN

(*Zea mays* L. *saccharata*)

M.Sc. (Ag.) THESIS

by

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DEPARTMENT OF AGRONOMY

COLLEGE OF AGRICULTURE

FACULTY OF AGRICULTURE

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EFFECT OF DIFFERENT ORGANIC WEED MANAGEMENT PRACTICES ON GROWTH AND YIELD OF SWEET CORN

(*Zea mays* L. *saccharata*)

Thesis

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JEEVAN LAL PAINKRA

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SEPTEMBER, 2021

CERTIFICATE – I

This is to certify that the thesis entitled **"Effect of different organic weed management practices on growth and yield of sweet corn *(Zea mays* L. *saccharata)*"** submitted in partial fulfillment of the requirements for the degree of **Master of Science in Agriculture** of the Indira Gandhi Krishi Vishwavidyalaya, Raipur is a record of the bonafide research work carried out by **Jeevan Lal Painkra** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instructions.

No part of the thesis has been submitted for any other degree or diploma or has been published/published part has been fully acknowledged. All the assistance and help received during the course of the investigations have been duly acknowledged by him.

Date: 14/09/21

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Member	**Dr. R. R. Saxena**	.....
Member	**Dr. H. L. Sonboir**	.....

CERTIFICATE – II

This is to certify that the thesis entitled **"Effect of different organic weed management practices on growth and yield of sweet corn *(Zea mays* L. *saccharata)*"** submitted by **Jeevan Lal Painkra** to the Indira Gandhi Krishi Vishwavidyalaya, Raipur, in partial fulfillment of the requirements for the degree of **Master of Science in Agriculture** in the **Department of Agronomy** has been approved by the external examiner and Student's Advisory Committee after oral examination, under the chairmanship of head of the Department.

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Approved / not approved _____

Director of Instructions _____

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LIST OF ABBREVIATIONS

Notations used	Description
%	Percent
@	At the rate
B:C	Benefit cost ratio
^{0}C	Degree Celsius
CD	Critical difference
CG	Chhattisgarh
CGR	Crop growth rate
cm	Centimetre
Cob^{-1}	Per cob
DAS	Days after sowing
et al.	And co-worker/ and others
Fig	Figure
g	Gram
Hrs	Hours
Ha	Hectare
ha^{-1}	per hectare
i.e.	That is
K	Potassium
kg	Kilogram
Kmph	Kilometre per hour
LA	leaf area
LAI	leaf area index
m	Metre
mm	Millimetre
ml	Milliliter
m^{-2}	per metre square
Max	Maximum
Min.	Minimum
N	Nitrogen
NS	Non significant
No.	Number
Plant^{-1}	Per plant

Row^{-1}	Per row
Rs	Rupees
RH	Relative humidity
spp.	Species
SEm ±	Standard error of mean
T	Tonnes
viz.	For example
WCE	Weed control efficiency
WGR	Weed growth rate
WI	Weed index

THESIS ABSTRACT

a) Title of the Thesis	:	**"Effect of different organic weed management practices on growth and yield of sweet corn *(Zea mays* L. *saccharata*)"**
b) Name of the Student	:	Jeevan Lal Painkra
c) Major Subject	:	Agronomy
d) Name and Address of the Major Advisor	:	Dr. Shrikant Chitale Department of Agronomy College of Agriculture, IGKV, Raipur, C.G.
e) Degree to be awarded	:	M.Sc. in Agriculture (Agronomy)

Signature of the Student

Signature of Major Advisor

Date: 14/09/21

Signature of Head of the Department

ABSTRACT

Experiment was conducted during rabi season of 2020-21 at the Instructional cum Research Farm IGKV, Raipur, Chhattisgarh to study the "Effect of different organic weed management practices on growth and yield of sweet corn *(Zea mays* L. *saccharata*)" with the objective to study the growth and yield of sweet corn under different organic weed management practices.

The field experiment was worked out under randomized block design with three replications having eight different weed management treatments namely.T_1- Hand weeding twice at 20 and 40 DAS, T_2- Black polythene mulch (20 micron

thickness), T_3- Paddy straw mulch 5 tonne ha^{-1}, T_4- Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS, T_5-Hand hoe twice at 20 and 40 DAS, T_6- Live mulching with green gram (incorporation 30 DAS), T_7- Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS and T_8-Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS. The soil of experimental field was clayey in texture, neutral in reaction having 0.65 % of carbon, low in available N (120 kg ha^{-1}), medium P_2O_5 (17.42 kg^{-1}) and high K_2O content (319.0 kg ha^{-1}). The sweet corn variety Sugar 75 was sown on 31 December 2020 with a spacing of 40 × 30 cm except in treatment of stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS, where the spacing was maintained at 32 × 30 cm. The recommended dose (80: 50: 30 NPK kg ha^{-1}) was applied through organic sources i.e. 50 % N through FYM, 25 % N through vermicompost and 25 % N through poultry manure. The entire quantity of FYM and poultry manure was applied as basal, while 50 % vermicompost was applied in two equal splits each at Knee-high and pre-tasseling stage of sweet corn.

The weed flora present in experimental site was *Medicago denticulata, Chenopodium album, Echinochloa colona, Alternanthera sessilis, Cyperus spp* and *Cynodon dactylon*. Among all the different weed management practices, black polythene mulch (T_2) was found superior owing to the lowest weed count and weed dry weight. At 20 DAS, the lowest count of weeds was recoded under black polythene mulch (T_2) followed by stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) was next in order which was followed by paddy straw mulch 5 t ha^{-1} (T_3). The higher density of weed was recorded under weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS. At 40 and 60 DAS and at harvest, black polythene mulch (T_2) treatment was found superior over all the treatment as there were lowest weeds count in this treatment.

The weed control efficiency was worked out in comparison to T_6 (live mulching with green gram incorporation at 30 DAS) treated as control. The highest weed control efficiency (84.55 %) was found at 60 DAS in black polythene mulch

(20 micron thickness) and it was followed by stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (70.68 %), paddy straw mulch 5 t ha^{-1} (70.04 %) and hand weeding twice 20 and 40 DAS (60.76 %). The lowest WCE% (30.24%) live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (T_7) plots.

All the growth parameter viz. plant dry matter accumulation, plant height number of leaves $plant^{-1}$, and CGR were found significantly superior under black polythene mulch (20 micron thickness) (T_2) followed by stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) as compared to rest of the treatments. The maximum yield attribute characters like no. of cobs $plant^{-1}$, no. of grains cob^{-1}, green cob yield and stover yield 7.42 and 16.17 t ha^{-1} were also registered significantly higher in black polythene mulch (20 micron thickness) (T_2) followed by stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4), paddy straw mulch 5 t ha^{-1}, and hand weeding twice 20 and 40 DAS.

The gross returns (Rs.254833 ha^{-1}), net returns (Rs.189302 ha^{-1}) and B:C ratio (3.89) was the maximum under the black polythene mulch (20 micron thickness) (T_2) followed by stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4).

शोधग्रंथ सारांश

अ) शोध ग्रंथ का शीर्षक	:	**"स्वीट कॉर्न (*जिया मेज एल. सैकेराटा*) की वृद्धि और ऊपज पर विभिन्न जैविक खरपतवार प्रबंधन का प्रभाव।**
ब) विद्यार्थी का पूरा नाम	:	जीवन लाल पैंकरा
स) प्रमुख विषय	:	सस्य विज्ञान
द) प्रमुख मार्गदर्शक का नाम और पता	:	डॉ. श्रीकांत चितले, सस्य विज्ञान विभाग कृषि महाविद्यालय (इं. गा. कृ. वि. वि.) रायपुर (छ.ग.)
ङ) सम्मानित की जाने वाली उपाधि	:	कृषि स्नातकोत्तर (सस्य विज्ञान)

छात्र का हस्ताक्षर

प्रमुख मार्गदर्शक के हस्ताक्षर

दिनांक 14/09/21

विभागाध्यक्ष के हस्ताक्षर

सारांश

प्रस्तुत परीक्षण 2020-21 के दौरान शैक्षणिक एवं अनुसंधान प्रक्षेत्र, इंदिरा गाँधी कृषि विश्वविद्यालय, रायपुर, छत्तीसगढ़ में **"स्वीट कॉर्न (*जिया मेज एल. सैकेराटा*) की वृद्धि और ऊपज पर विभिन्न जैविक खरपतवार प्रबंधन के प्रभावों का अध्ययन किया गया।** अध्ययन प्रमुख उद्देश्य विभिन्न जैविक खरपतवार प्रबंधन उपायों के तहत स्वीट कॉर्न की वृद्धि और उपज का अध्ययन करना था।

प्रयोग यादच्छिक ब्लॉक डिजाइन के तहत किया गया था, जिसमे तीन प्रतिकृति के साथ आठ अलग - अलग खरपतवार प्रबंधन उपचार थे। (टी-1) बुवाई के 20 एवं 40 दिन बाद हाथ से निंदाई , (टी-2) ब्लैक पॉलिथीन बिछावन (20 माइक्रोन मोटाई), (टी-3)धान का पुवाल बिछावन प्रति हेक्टेयर 5 टन (टी-4) निस्तेज बीज क्यारी + 25% अधिक पौध घनत्व + धान की पुआल बिछावन + बुवाई के 30 दिन बाद एक बार हाथ से निंदाई, (टी-6) मूंग का लाइव मल्चिंग (निगमन बुवाई के 30 दिन बाद), (टी-7) मूंग का लाइव मल्चिंग (निगमन बुवाई के 30 दिन बाद) + बुवाई के 30 दिन बाद एक इंट्रा रो हाथ से निंदाई (टी-5) बुवाई के 20 एवं 40 दिन बाद हैंड हो से निंदाई, (टी-8) खरपतवार मल्चिंग बुवाई के 20 दिन बाद (पंक्तियों के बीच में खरपतवारो की इन-सीटू मल्चिंग) + बुवाई के 40 दिन बाद हाथ से निंदाई ।

प्रायोगिक क्षेत्र की मिट्टी बनावट में चिकनी प्रतिक्रिया में तटस्थ थी । जिसमें उपलब्ध नाइट्रोजन (120), मध्यम फॉस्फोरस (17.42) और उच्च पोटैशियम (319.0 कि. ग्रा./ है.) और 0.65 % कार्बन उपलब्ध था 31 दिसंबर 2020 को स्वीट कॉर्न वैरायटी शुगर 75 को 40 × 30 सेमी के दूरी के अंतराल पर बोया गया था। निस्तेज बीज शैया के उपचार को छोड़कर जहाँ 25% अधिक पौध घनत्व रखा गया था वहां 32 × 30 सेमी के अंतराल से बुवाई की गई ।

पोषक तत्वों की अनुशंसित मात्रा नाइट्रोजन, फोस्फोरस, पोटैशियम (80:50:30 प्रति हेक्टेयर) जैविक स्त्रोतों के माध्यम से डाली गई। जिनमें 50% नाइट्रोजन , गोबर खाद के माध्यम से, 25% नाइट्रोजन वर्मीकम्पोस्ट के माध्यम से तथा 25% नाइट्रोजन मुर्गी खाद के माध्यम से डाला गया था, वर्मीकम्पोस्ट की 50% मात्रा को नी - हाई अवस्था और प्री- टैस्लिंग चरण में 2 बराबर भागों में डाला गया था

प्रायोगिक स्थल में मौजूद खरपतवारों में *मेडिकागो डेंटिकुलाटा, चिनोपोडियम एल्बम, इकैनोक्लोवा कोलोना, अल्टरनेथेरा सेसिलिस, साइपरस स्पीशीज* और *साइनोडोन डैक्टाइलॉन* प्रमुख थीं। सभी विभिन्न खरपतवार प्रबंधन उपायों में, काली पॉलिथीन बिछावन (20 माइक्रोन मोटाई) (टी -2) सबसे कम खरपतवार संख्या और खरपतवार के सूखे वजन के कारण बेहतर पाई गई। बुवाई के 20 दिन बाद काले पॉलीथिन मल्च (टी 2) के तहत खरपतवारों की सबसे कम संख्या को पुनः अंकित किया गया था, इसके बाद (टी-4) निस्तेज बीज क्यारी + 25% अधिक पौध घनत्व + धान की पुआल बिछावन + बुवाई के 30 दिन बाद एक बार हाथ से निंदाई क्रम में था जिसके बाद धान का पुवाल बिछावन प्रति हेक्टेयर 5 टन था (टी-3)।

खरपतवारों की अधिकतम संख्या बुवाई के 20 दिन बाद (टी-8) खरपतवार मल्चिंग बुवाई के 20 दिन बाद (पंक्तियों के बीच में खरपतवारों की इन-सीटू मल्चिंग) बुवाई के 40 दिन बाद एक बार हाथ से निंदाई हाथ से निंदाई उपचार के तहत दर्ज किया गया। बुवाई के 40 दिन और 60 दिन बाद पर एवं कटाई के समय, काली पॉलिथीन मल्च (टी-2) उपचार सभी उपचारों से बेहतर पाया गया क्योंकि इस उपचार में खरपतवारों की संख्या सबसे कम थी।

खरपतवार नियंत्रण दक्षता (टी-6) उपचार की तुलना में निकाली गई क्योंकि उपचार विवरण में कोई नियंत्रण उपचार नहीं था । बुवाई के 60 दिन बाद सबसे अधिक खरपतवार नियंत्रण दक्षता (84.55%) काली पॉलिथीन बिछावन (20 माइक्रोन मोटाई), (टी-4) निस्तेज बीज क्यारी + 25% अधिक पौध घनत्व + धान की पुआल बिछावन + बुवाई के 30 दिन बाद एक बार हाथ से निंदाई, (70.68%) एवं धान का पुवाल बिछावन प्रति हेक्टेयर 5 टन (70.04%) और (टी-1) बुवाई के 20 एवं 40 दिन बाद हाथ से निंदाई (60.76%) में रिकॉर्ड किया गया । सबसे कम खरपतवार नियन्त्रण दक्षता % (30.24%) मूंग का लाइव मल्चिंग(निगमन बुवाई के 30 दिन बाद) + बुवाई के 30 दिन बाद एक इंट्रा रो हाथ से निंदाई उपचार में रिकॉर्ड किया गया ।

वृद्धि मापदण्ड जैसे- पौधे के सूखे पदार्थ का संचय, पौधों की ऊंचाई, फसल वृद्धि दर काले पॉलीथिन मल्च (20 माइक्रोन मोटाई) (टी-2) और (टी-4) निस्तेज बीज क्यारी + 25% अधिक पौध घनत्व + धान की पुआल बिछावन + बुवाई के 30 दिन बाद एक बार हाथ से निंदाई अन्य उपचारों की तुलना में काफी बेहतर पाए गए। उपज की गुणवत्ता विशेषता जैसे - भुट्टो की संख्या प्रति पौधे, प्रत्येक भुट्टे में दाने की मात्रा, हरे भुट्टे की उपज और मक्का पुवाल की उपज (7.42 टन और 16.17 टन प्रति हेक्टेयर) भी काले पॉलीथिन बिछावन (20 माइक्रोन मोटाई) में काफी अधिक दर्ज किए गए थे, इसके बाद (टी-4) निस्तेज बीज क्यारी + 25% अधिक पौध घनत्व + धान की पुआल बिछावन + बुवाई के 30 दिन बाद एक बार हाथ से निंदाई, तथा धान का पुवाल बिछावन प्रति हेक्टेयर 5 टन, और (टी-1) बुवाई के 20 एवं 40 दिन बाद हाथ से निंदाई में रिकॉर्ड किया गया ।

ब्लैक पॉलिथीन बिछावन (20 माइक्रोन मोटाई) (टी-2) के तहत सकल रिटर्न (रु. 254833 प्रति हेक्टेयर), अधिकतम शुद्ध लाभ (रु. 189302 प्रति हेक्टेयर) और लाभ लागत अनुपात (3.89) अधिकतम था, इसके बाद निस्तेज बीज क्यारी + 25% अधिक पौध घनत्व + धन की पुआल बिछावन + बुवाई के 30 दिन बाद एक बार हाथ से निंदाई में पाया गया ।

CHAPTER-I
INTRODUCTION

In India maize is grown almost in all the states. It is grown in 9380 thousand hectare area and its production is 28754 thousand tone with a productivity of 3064 kg ha^{-1} in India (Anonymous 2018). It is cultivated in 133.41thousand hectare area and production is 318.52 thousand tonne with an average productivity of 2584 kg ha^{-1} (Anonymous 2018).

Sweet corn "(*Zea mays* L. *saccharata.)"* also known as Indian corn, sugar corn, is a variety of maize with a high sugar content and eaten in the immature stage, It is grown primarily as a food and is harvested with about 70 % moisture before hardening and drying of the grain starts. It is a verry rich source of vitamin **A** and **C** and generally used for human consumption. It is an important source of fibre, minerals, and certain vitamins. It is also used in and as vegetable and preparation of soup, salad and other recipes. This corn is differentiated from other types by the presence of specific genes that affect starch synthesis in the endosperm. It is becoming very popular in country therefore; its cultivation is remunerative for peri-urban farmers. Besides each part of the corn plant is useful and nothing goes to waste. The green fodder is also available to the farmers for their animal feed.

Sweet corn is picked up at immature stage and must be eaten fresh before the kernel become tough and starchy. Corn in milky stage has the highest edible quality. It contains best nutritional quality carbohydrate (80%), and total solids (21.3%), protein (13%) and lipids (3.4%). "Sweet corn (*Zea mays L. var. Saccharata*)" is a good source of energy 90 kcal with very high sugar content. Sweet corn required minimum soil temperature for germination of 13 °C and optimum soil temperature range 21 °C to 28 °C for root development. Sweet corn responds well to gentle warm condition with an optimum air temperature of 21 °C to 30 °C.

Sweet corn provides higher amount of net income and benefit cost ratio as compared to maize. In view of high economic return and production potential of maize in the Chhattisgarh. there is huge scope of sweet corn to improve economic status of poor maize growers. It is a traditional fact that higher grain yield depends

on adequate weed management strategy. Maize crop is sensitive to weed competition during early growth phase due to slow growth in the first 3-4 weeks. Weeds emerge with the germination of maize seed and grow along with plants. Different type of weed flora are found in maize field classified as narrow leaf weed, broad leaf, grasses, and sedges. Weed interference is a severe problem in corn growing especially in the early part of the growing season. Weeds are competing for resources such as water, sunlight, nutrient, carbon dioxide, and consequently interfere with the normal growth of crops. Weeds create harvesting difficult and they reduced yield of crop. Weeds are highly influence the morphology and phenology of maize crop (Oerke *et al*.,2005).

The critical period of weed competition in the maize crop is 15 to 45 DAS and competition in these stages had a major effect on yield potential. If weeds are not controlled in this critical period, there is grain losses between 35 and 72 % depending upon weed species and density (Ashique *et al*.1997). Further, the magnitude of huge losses caused by the weeds and largely depend on weed flora composition, crop-weed competition and intensity of weed (Mannan *et al*.,2006).

Weed problems in rabi sweet corn is different from kharif season. In kharif season grown sweet corn, weed emergence starts at 15- 45 DAS and it is the most critical period to crop - weed competition whereas in rabi sweet corn weeds are emerged after the first irrigation. In rabi season *Medicago denticulata, Echinochloa colona, Chenopodium album, Alternanthera spp., Cyperus spp., Cynodon etc.* are commonly found major weed flora in sweet corn growing areas.

Weed control is recognized as the greatest production related problem in "organic farming" and one of the major reasons why conventional farmers do not convert to organic production (Kruidhof *et al.* 2009). Early growth stage of sweet corn is most sensitive to weed competition. The higher weed competition occurs during the period of 3 to 6 weeks after sowing of maize. This recommends the critical period of crop-weed competition and importance of maintaining the weed free condition of field.

Although, there is a cost-effective chemical weed control in sweet corn and other crops through herbicide but as the organic products gives always higher price

in market than the normal product and consumers attract to them due to its chemical free quality and taste. Even use of organic manure and biofertilizers not only improve soil health but also help to sustain crop productivity. Hence, alternate weed management options may be explored to replace chemicals, which are not only to be economically effective for weed control but also beneficial for higher productivity and profitability of sweet corn.

Different kinds of materials are used to some extent as mulch for controlling weeds and for other purpose. Some of these mulches are organic mulches as dust or soil, weeds or trash, crop residue or stubbles, saw dust, straw and some are artificial mulches such as polyethylene, paper sheet, and manmade fiber materials (Khan *et al* 2011). It is important for agriculture field because it reduces the need for chemical sprays. it causes conservation of water and soil. It improves soil structure and addition of soil organic substance, regulating soil temperature and returning the productivity of of degraded land (Srivastava *et al.,*1993). A layer of black polythene provides an effective barrier to weeds. Light cannot penetrate the dark color (as compared to clear plastic), in that way avoiding weeds seeds from germinating and growing. Organic mulch includes grasses, plant leaves, barks, woodchips, crop straw all of which can retain the nutrients found in these organic matters. Live mulching of any fast-growing pulse can be an effective method to be used for the control of weeds.

Hence, the present investigation **"Effect of different organic weed management practices on growth and yield of sweet corn''(*Zea mays* L. *sachharata*)**" was conducted during the *Rabi* 2020-21 at Research cum Instructional Farm, Indira Gandhi Krishi Vishwa Vidyalaya, Raipur, (C.G) with the following objectives :-

1. To study the growth and yield of sweet corn under organic weed management.
2. To study the effect of organic weed management on weed dynamics in sweet corn.
3. To work out the economics of various organic weed management treatments.

CHAPTER – II

REVIEW AND LITERTURES

A compilation of review on available research work done on "Effect of different organic weed management practices on growth and yield of sweet corn *(Zea mays* L. *saccharata*)" is presented in this chapter. Work done on these aspects on organic sweet corn is meagre, hence relevant research finding on maize, specially corn and other crops have also been included wherever felt appropriate.

Weed Management

2.1 Effect of organic weed management practices on crop

2.1.1 Crop growth

2.1.2 yield attributes and yield

2.2 Effect of organic weed management practices on weeds

2.2.1 Weed flora associated with crop

2.2.2 Critical period of crop-weed competition

2.2.3 Weed dynamics and growth

2.2.4 Weed control efficiency (%) and Weed index (%)

2.3 Economics of various organic weed management practices of organic sweet corn.

2.1.1 Effect on crop growth

Sinha *et al*. (2001) stated that the higher crop growth rate, higher LAI and maximum dry matter accumulation were observed under two hand weeding in kharif maize. While, Shekhawat and Gautam (2002) stated the maximum standards of all the growth attributes in maize were found in weed free plots followed by spraying of atrazine 1.0 kg ha^{-1} or hand weeding twice as compared to the untreated control plots.

Bhatt *et al.* (2004) reported that dry matter production with paddy straw mulch was 138% higher than the dry matter production from bare plots at Ludhiana.

Rana *et al*. (2006) revealed that the use of farmyard manure (FYM) + dust mulch + straw mulch was significantly enhanced the growth of plant, yield attributes and yield of maize over no mulched plots.

Khurshid *et al.* (2006) stated that the maize crop grew taller under greater mulch levels, because of availability of more soil moisture contents for plant growth and development.

Mahajan *et al*. (2007) reported that rice straw mulch attained more plant height, stem diameter, leaf area as compared to unmulched soil condition due to excellent weed control, high water use efficiency in plastic mulch along with the early and vigourous growth of plant. They also noticed that by using of black polythene mulch and paddy mulch, baby corn seedling emerged 2 and 4 days earlier, respectively. This was due to increased minimum soil temperature and soil moisture content in the upper portion of the soil, which provided an ideal environment for early germination and vigorous growth of the plant particularly at the initial growth. They also observed that weed population under paddy straw and plastic mulch was found statistically at par but significantly decreased over unmulched soil condition. The paddy straw mulch provided good control over weeds at the initial stage, but in the later season of the crop growth, heavy infestation caused increased dry matter accumulation by weeds.

Sarma (2007) revealed that two hand weedings at 25 DAS and 45 DAS resulted in significantly higher plant height, dry matter accumulation and yield attributes as compared to unweeded control at Pantnagar.

Gul *et al.* (2009) recorded dry weight of maize plant on 70 DAS was differently affected by various mulches. The most dry weight change was determined in black plastic (535.1 gm^{-2}) accompanied with the aid of using hand weeding (534.1 gm^{-2}) comparison to weedy check plots (105.7 gm^{-2}). This change was due to the fact that the crop plant life amassed from black plastic possessed massive cobs compared to different remedies.

Pervaiz *et al.* (2009) stated that the maximum plant height was recorded in the treatment where weed were used as mulch (144.9 cm) accompanied with the aid of using black plastic (142.2 cm) compared to weedy check plots (100.6 cm).

Verma *et al*. (2009) stated that hand weeding at 20 and 40 DAS in maize exhibited 75.70 % weed control efficiency as well as the maximum plant height (211.18 cm), dry weight of plant (278.44 g plant^{-1}) and crop growth rate (4.08 g) day^{-1} as opposition to weedy check at harvest of crop.

Mehmood *et a*l. (2018) reported that the application of rice straw mulch 6 t ha^{-1} resulted in higher dry matter accumulation of maize. While, Yi *et al.* (2011) reported that film mulch helped in early vigorous growth in maize with increased plant height, leaf and stem diameter compared to other treatments.

Rajput *et al*. (2014) found that the maximum mean number of leaves, plant height, leaf area index and chlorophyll content was recorded under dust mulch, which was statistically at par with rice straw mulch and significantly superior over control (no mulch).

2.1.2. Yield attributes and crop yield

Li *et al*. (1999, 2004) found that the maize crop used with different types of mulch material performed differently, black plastic mulch harvested the maximum cob yield during both the years over rest of the mulches. Paddy straw mulch was next to it. No mulch with weed free condition was comparable with straw mulch during 2012 but during 2013 the cob yield in straw mulch was greater over no mulch with weed free treatment.

Nawab *et al.* (1999) assessed that the maximum stover yield was recorded in black polythene mulch (3.77 kg) and (3.4 kg) weeds as mulch plots as compared to weedy check plots (1.5 kg).

Easson and Fearnehough (2000) found that the use of plastic and other mulch treatments increased the grain yield and stover yield significantly as compared to weedy check plots.

Sharma *et al*. (2000) suggested the combination of hand hoeing at 15 days and earthing up at 30 DAS to produce higher grain yield of maize and long duration weed free condition over weedy plots.

Kwabiah (2003) found that the modification in microclimate as encouraged by plastic mulch increased the dry matter accumulation, yield and quality of field corn.

Bhatt *et al.* (2004) stated that straw mulch of paddy showed the maximum number of grain cob^{-1} (419) followed by legume mulch (418) and other treatments were statistically different from paddy straw mulch.

Kwabiah (2004) stated that the higher 1000 kernel weight in hand weeded and black plastic plots might be due maximum dry matter accommodation and higher resources availability. However, the less 1000 kernel weight might be due to improper nutrients availability and heavy weed infestation in weedy check plots.

Mandal *et al*. (2004) revealed that hand weeding twice increased net returns and B:C ratio, fodder yield, number of cobs $plant^{-1}$, cob weight, cob length, cob yield, over weedy check. Sinha *et al*. (2005) reported that two hand weeding at 25 and 45 DAS in maize crop produced about 66.6 % increase in maize grain yield over weedy check.

Meyyappan and Kathiresan (2005) reported that increased maize garin yield by 2.43 times higher in two hand weeding than weedy check. Similarly, Sarma and Gautam (2006) reported that hand weeding at 25 and 45 DAS produced higher grain yield and lower weed dry weight and weed population at silking and maturity stages than weedy check plots.

Kamble *et al*. (2005) revealed the higher maize grain yield (70 q ha^{-1}) with two hoeing + two hand weedings at 20 and 40 DAS as compared to unweeded check. While, Chikoye *et al*. (2004) found the higher maize grain yield from hoe - weeded control due to good weed control.

Nagalakshmi *et al*. (2006) suggested that hand weeding twice at three and six weeks after sowing increase the grain yield of maize significantly when compared with the weed free control plots.

Patel *et al*. (2006) revealed that hand weeding at 25 and 45 DAS produced the significantly the maximum yield and lower weed dry weight and minimum weed density at silking and maturity stages of kharif maize. While, Singh *et al*. (2007) observed that hand weeding twice at 20 and 40 DAS proved to be most effective followed by alachlor at 2 kg ha^{-1} + hand weeding at 30 DAS and they reduced weed population and weed biomass significantly in maize grown under rainfed condition at Faizabad.

Prasad *et al.* (2008) computed the maximum weed control efficiency (70.91 %) and found increased maize grain yield by 57.48 % with manual weeding twice 20 and 40 DAS in comparison to weedy check at Kanpur.

Rao *et al*., (2009) reported that the two hand weeding at 15 and 30 DAS produced the maximum plant height, number of cobs $plant^{-1}$, number of grains cob^{-1}, 1000 seed weight and additionally gave maximum yield (105.2 q ha^{-1}) as compared to control plots. While, Singh *et al*. (2009) stated that two hand weeding in maize at 20 and 40 DAS, produced pointedly higher dry matter at 90 DAS and 207.3 and 211.2 % greater yield over unweeded check in a two years study.

Gosavi *et al*. (2009) reported the effect of rice straw and transparent black polythene mulches on sweet corn (*Zea mays saccharata*) and revealed that significantly increased the lenth of cob, weight of cob, cob diameter with husk and number of kernel cob^{-1} and green cob yield after applied black polythene mulch as compared to other treatment.

Verma *et al*. (2009) revealed that the manual weeding accompanied with the aid of using earthing operation at 20 days after sowing constrained the weed competition (85.97 % WCE) which resulted in advanced value of yield attributing characters i.e., plant height (31.99 %), culm girth (37.81 %), plant dry weight (41.55 %), LAI (76.1 %), and CGR (37.63 %) more than that of weed free control having lowest value of similar parameters.

Sharma and Gautam (2010) found notably better maize yield (26 and 69 %) with the aid of using hand weeding at 25 and 45 DAS over weedy check plots at Pantnagar.

Sarma *et al*. (2010) observed that two hand weeding at 25 and 45 DAS was best in producing the maximum grain yield of maize laterally with lowest weed density (4.1 %) and weed dry weight (3.2 %).

Gul *et al.* (2011) found that the maximum number of grains cob^{-1} was recorded in the hand weeding plots (279) and black polythene mulch (270) followed by weed mulch (252), and living mulch (246) against weedy check (221).

Uwah and Iwo (2011) observed the effects of organic mulch on weed growth and maize productivity. They found the highest weed infestation in un - mulched plots, whereas the minimum weed infestation was experienced in mulched plots with yield of 8.2 t ha^{-1}. The exploitive effect of weed at 2, 4 and 6 t ha^{-1} rates of mulch were statistically comparable but also significantly higher than the control plots.

Gul *et al.* (2011) reported that hand weeding at 25 DAS (2862 kg) and black plastic mulch (2812 kg) exhibited higher grain yield, and next to weeds mulch (2460 kg) and white plastic mulch (2399 kg), followed by living mulch (2145 kg) against 1422 kg ha^{-1} in weedy check.

Arif *et al.* (2011) observed the number of grains cob^{-1} was significantly affected by applying mulches and found that the black plastic (196.5) and weeds as mulch (177.8) were the best treatments for the number of cob $plant^{-1}$, number of kernel cob^{-1} of the maize compared with weedy check plots (67.64).

Ramzan *et al.* (2012) stated that paddy straw mulch significantly increase the 100 grain weight cob^{-1} (21.62 g) accompanied with the aid of using legume mulch. The minimum 100 grain weight of cob^{-1} (15.15 g) was recorded under control.

Xue *et al*., (2013) assessed the paddy straw mulch which significantly improved the plant height, in term of leaf area, number of leaves $plant^{-1}$, numbers of cob^{-1}, cob diameter and stem girth.

Ahmed *et al*. (2013) obtained the maximum grain yield (5.14 t ha^{-1}), biological yield and stover yield with relatively increase in different yield

characteristics *viz*, number of cobs plant^{-1}, cob length, cob diameter, number of rows cob^{-1}, number of grains row^{-1}, 1000 grains weight with polyethylene mulch. Plants reached phenological stages two to four days earlier with the help of Polyethylene as compared to control plot. In the polyethylene mulched plots the soil temperature was 6-8°C higher as compared to un-mulched plots. The resulted modification of crop ecology produced 73.4% and 72.6% more grain yield with polyethylene mulch and straw mulch, as related to uncontrolled weedy check.

Sanodiya *et al*. (2013) reported that hand weeding twice at 20 and 40 DAS produced higher seed yield and stover yield over the other treatments. While, at Junagarh, Barad *et al*.,(2015) assesed that the pre-emergence spraying of atrazine 0.5 kg ha^{-1} followed by 1 HW and inter-cultivation at 30 DAS gave significantly, increased the maize plant height, number of leaves, dry matter accumulation plant^{-1}, grain weight cob^{-1}, maize grain yield and fodder yield by 34.4%, 43.0%, 29.0%, 174.3% and 145.7%, over weed free control.

Rajput *et al*. (2014) found that the cob length was the maximum in rice straw mulch after that legume mulch which is at par with each other.

Kumar *et al*. (2017) found that 2 HW at 25 DAS and 45 DAS produced the maximum grain yield of (8.91 t ha^{-1}), lowest density of weeds and weed dry weight.

Youngerman *et al.* (2018) reported that with and without inter seeded cover crops at the same standard corn planting density, the corn grain yield did not differ. Weed biomass was 32% lower in plots with inter seeded cover crops compared to plots without inter seeded.

2.2 Effect of organic weed management practices on weeds

2.2.1 Weed flora associated with crop

Porwal (2000) found *Melilotus indica, Medicago denticulata, Convolvulensis arvensis, Euphorbia hirta, Chenopodium album* among broad leaved weeds; *Cyperus rotundus* among sedge and *Cynodon dactylon* among grass were the dominant weeds in maize during winter season.

Pandey *et al.,* (2001) found that major weed flora present in the experimental field at Uttaranchal were, *Digitaria ciliaris, Dactyloctenium aegyptium, Echinochloa colonum* and *Panicum repens* among grasses; *Commelina bengalensis, Ageratum conyzoides, Euphorbia geniculata,* and *Oxalis latifolia* among broad leaved weeds and *Cyperus difformis, Cyperus iria, Cyperus rotundus* among sedges during kharif season.

Mundra *et al*. (2003) reported that the predominant weed species in maize were *Alternanthera sessilis, Commelina benghalensis, Cyperus rotundus, Amaranthus spinosus, Cynodon dactylon, Echinochloa colona, Digera arvensis, Parthenium hysterophorus, Dinebra retroflexa and Trianthema portulacastrum* in Rajasthan.

Sinha *et al*. (2003) observed that the important weed species associated with maize crop were *Sorghum halepense, Cyperus rotundus, Anagallis arvensis, Cynodon dactylon, Chenopodium album, Cannabis sativa, Convolvulus arvensis,* and *Melilotus alba* in silty loam soils of Pusa, Bihar.

Audi Reddy *et al.* (2004) reported that various types of weed flora found in maize viz., among grasses; *Cynodon dactylon, Chloris barbata, Setaria verticellata, Dactyloctenium aegyptium,* among sedges- *Cyperus rotundus* and among broad leave weeds- *Portulaca oleracea, Digera arvensis, Parthenium hysterophorus, Trianthema portulacastrum,* and *Gynandropsis pentaphylla*.

Kamble *et al*. (2005) found the major weed flora present in the experimental field in maize comprised of broad-leaved weeds such as *Euphorbia geniculata, Euphorbia hirta, Digera arvensis, Celosia argentea* and *Lagasca mollis* and the narrow leaf weeds such as *Dinebra retroflexa, Cyperus rotundus,* and *Cynodon dactylon*. While, Patel *et al*. (2006) found that the major weed flora in maize field were *Dactyloctenium aegyptium, Eleusine indica, Eragrostis major,* and *Digitaria sanguinalis* as monocot weeds and dicot weeds such as *Phyllanthus niruri, Euphorbia hirta, Digera arvensis and Boerhavia diffusa.*

Arvadiya *et al*. (2012) revealed that major weed flora in the field of sweet corn were among monocots *Cynodon dactylon,* and *Echinochloa crusgalli,* among

sedges *Cyperus rotundus* and among dicots *Trianthema spp*. *Amaranthus viridis, Alternenthara sessilis, Digera arvensis,* and *Portulaca oleracea.*

Madhavi *et al.* (2014) found wide range of weed flora in maize, viz. *Echinochloa colona, Cyperus rotundus*, *Commelina benghalensis* and *Trianthema portulacastrum* dominated during early stages of the crop growth whereas *Dactyloctenium aegyptium* toward the tasseling and maturity of the crop.

Mahmood *et al.* (2015) found the major weeds of maize crops namely *Cyperus rotundus, Alternanthera pungens, Digeria arvensis, Sorghum helepense, Amaranthus hybridus, Echinochloa colona,* and *Tribulus terrestris,* account for 23-89% invasion under field condition.

Singh *et al.* (2015) observed that Cyperus rotundus, Cyperus iria and Trianthema portulacastrum were the dominant weed species in spring maize at Hissar.

Stanzen *et al*. (2016) found weeds during rabi season were *Phalaris minor*, *Cynodon dactylon, Poa annua* among grasses and *Anagallis arvensis*, *Circium arvense* and *Chenopodium album, Medicago denticulata,* among broad leaf weed.

Barla *et al.* (2016) reported that the major weed flora found in experimental field was infested with broadleaved weeds viz. *Alternenthara sessils, Commelina nudifolia, Ageratum conyzoides, Phyllanthus niruri,* among grasses *Echinochloa colona, Echinochloa crusgalli, Digitaria sanguinalis, Paspalam distichum, Dactyloctenium aegyptium* and *Fimbristylis milliacea, Cyperus iria and Cyperus rotundus,* among sedges.

2.2.2 Critical period of crop-weed competition

Shad *et al.* (1993) reaveled that the critical crop-weed competition in maize was found to be in among three and five weeks after sowing.

Sen *et al*., (2000) stated that maize grows very slowly during early stages and due to that it subjected to vigorous competition from a wide variety of weeds and found yield losses from 15 to 75 % in maize crop due to competition of weed spp.

Irvine and Radboud, (2000) reported that during the first six weeks after germination of maize, weeds are very competitive. It was found that three weeks after germination there were on an average of 55 weed plants for every maize.

Porwal (2000) reported that the un-weeded situation beyond 30 days and up to 45 DAS caused injury to the growth of maize crop and yield loss.

Knezevic *et al*., (2002) defined the critical periods for weed management as the period in the crop growth cycle during which weeds must be controlled to prevent improper yield losses. The critical period of weed competition in the maize crop is 15 to 45 DAS.

Nedim *et al.* (2004) reported that a weed-free period between the 3 -7 and 7 - 10 leaf stages of the crop was sufficient to prevent yield losses under the growing conditions of maize in Turkey.

Kamble *et al*. (2005) stated that the critical stage in maize crop was between 30 to 45 DAS as crop weed competition.

Habibi *et al*., (2008) reported that the period of peak competition between weed and corn was found among 4^{th} to 10^{th} leaf stage and showed that if weeds were controlled within this peak competition period, the yield of corn could be protected.

Yakadri *et al*. (2015) found that wider spacing and initial slow growth rate of maize in the first 3-4 weeks provided enough time for weeds to spread and control have severe competition, which resulted in 30-94 % yield losses.

Imoloame and Omolaiye (2017) concluded that in order to get optimum yield and net return, maize plot should be kept free from weed between 21 to 42 DAS which is the critical period of weed interference in maize.

2.2.3 Effect on weed dynamics and growth

Thakur and Sharma (1996) stated that hand weeding twice at 20 and 40 DAS showed significantly lower weed density and lower dry matter content of weeds in comparison to control plots.

Kandasamy *et al*. (1998) reported that the intercultural operations, like mechanical weeding or two hand weeding at 25 and 45 days after sowing effectively controlled the weed density and increased maize yield.

Gallandt *et al.* (1999) reported that surface application of crop residues as mulch affects weed dynamics and population by delaying seed germination and establishment and suppressing individual weed growth resultant contributing to overall decline in the population and vigor of the weed community.

Sharma *et al*. (2000) found that hoeing at 15-20 DAS effectively controlled the weed population at 30-35 DAS, which was less than half (23-33 m^{-2}) weeds as compared with no intercultural operation (67-71 weeds m^{-2}).

Cheema *et al*. (2004). reported that purple nutsedge reduced the dry weight by 38-42% after applying sorghum mulch 10-16 t ha^{-1} as compared to control.

Kumar and Thakur (2005) recorded the maximum reduction in density of weed population and dry weight of weeds under hand weeding compared to herbicides applied treatments at Kangra.

Sinha *et al*. (2005) recorded the lowest NPK depletion by weeds in hand weeding twice at 20 and 40 DAS in maize when compared to control treatment as well as herbicide (alachlor at 1.5 + atrazine at 1.5 kg ha^{-1} PoE) applied treatments.

Abouziena *et al*. (2008) concluded that the competitive capacity of maize improved against the population of weeds in manual hoeing at 25 and 45 DAS and lower down the dry weight of broadleaf weeds and grasses at 60 DAS significantly from 38.8 m^{-2} and 106.2 g m^{-2} (control plots) to 5.6 m^{-2} and 1.7 g m^{-2} respectively. Sunitha *et al*. (2010) reported that HW twice at 15 and 35 DAS in sweet corn significantly helped in reducing population of sedges, grasses and broad leaf weeds at 45 DAS.

Khan and Pervej (2010) reported that applying different types of mulches significantly affected the fresh weights of weeds taken at 40 and 70 DAS. The lowest value for fresh weights of weeds was recorded in black plastic (64.8 gm^{-2}) followed by hand weeding (76.3 gm^{-2}) at 45 DAS and hand weeding (82 m^{-2}), black plastic (178.7 m^{-2}) at 70 DAS as compared to weedy check plots (1419.8 m^{-2}) and (606.2 m^{-2}).

Khaliq *et al.* (2010) reported that significantly the lowest dry weights of weeds was found in mulches applied plots (396.23 g m^{-2}) and hand weeding plots (178.93 g m^{-2}) comparable to control plots.

Gul *et al.* (2011) reported that weed fresh "biomass" was significantly lower in hand weeding plots due to the removal of weed density at initial stage of the crop.

Uwah and Iwo (2011) assessed the effects of organic mulch on weed growth and maize productivity. They reported the highest weed infestation in unmulched plots, while the minimum weed infestation was experienced in mulched plots with yield of 8.3 t ha^{-1}. The suppressive effect of weeds at 2, 4 and 6 t ha^{-1} rates of mulch were though statistically similar but also significantly higher than the control plots.

Kumar *et al*. (2012) reported that hand weeding twice 25 and 45 DAS effectively reduced the population of *Commelina spp*. Whereas, Choudhary *et al*. (2013) revealed that reduced weed population and lower dry matter content and nutrient uptake by weeds in two hand weeding at 15 and 30 DAS and produced 42.2 % higher grain yield than weedy check.

Sonawane *et al*. (2014) reported that hand weeding twice at 20 and 40 DAS resulted in reduction of weed population of 42.0 m^{-2} and 30.33 m^{-2} at 60 DAS and attained the maximum weed control efficiency and the minimum weed index. Similarly, Kumari *et al*. (2015) revealed that two hand weedings at 20 and 40 DAS allowed dry weight of weed 89.8 g per 0.25 m^{-2} at harvest against control condition based on original values.

2.2.4 Weed control efficiency (%) and Weed index (%)

Kandasamy and Chandrasekhar (1998) reported that the traditional method of non-chemical control effectively reduced the weed competition and increase the grain yield in maize.

Singh *et al*. (2001) recorded higher WCE of 82.2 percent with two hand weeding done at 15 and 30 DAS as compared to control plot.

Audi Reddy *et al*. (2004) found that the maximum weed control efficiency was recorded in hand weeding at 30 and 60 DAS, which was at par with the application of atrazine 0.2 kg ha^{-1} as pre-emergence integrated with mechanical weeding at 3-4 weeks after sowing.

Tripathi *et al*. (2005) stated that manual weeding twice registered the reduction of *Cyperus rotundus* (23.2%), *Digeria arvensis* (17.6%), *Phyllanthus niruri* (22.0 %) and *Commelina benghalensis* (20.3%) population resulting in heavy decline in weed dry weight and higher weed control efficiency (88.8 %) in rainy season maize in Central Uttar Pradesh.

Malviya and Singh (2007) suggested that hand weeding twice at 20 and 40 DAS was the most effective method to achieve WCE (60.7%) and significantly reduced the density of weeds and weed dry weight as compared to weedy check. Similarly, Prasad *et al*. (2008) found that the manual weeding at 15 and 30 DAS recorded the highest weed control efficiency (70.9 %) with grain yield of 32.2 q ha^{-1}.

Gul *et al.* (2009) reported that the maximum weed control efficiency was recorded under two hand weeding 20 and 45 DAS and mechanical weeding at 20 DAS and one HW at 45 DAS.

Verma *et al*. (2009) stated that two hand weeding at 20 and 40 DAS in maize exhibited weed control efficiency (75.7 %) as well as higher plant height (211.1 cm), dry weight of plant (278.4 g $plant^{-1}$) and crop growth rate (4.08 g of dry matter day^{-1}) as against weedy check at harvest of crop.

Singh *et al*. (2009) found that in maize, hand weeding twice at 20 and 40 DAS responsible for significant reduction in the density of weeds as well its dry matter content and resulted in 60.25 % and 71.21 % WCE during two consecutive years, respectively.

Verma *et al.* (2009) reported that hand weeding twice showed 87.5% WCE and one weeding followed by earthing up treatment exhibited maximum WCE (92.8%) at 45 DAS signifying the suppression of first flush of weeds effectively in maize.

Alok *et al*. (2012) found the hand weeding once at 30 DAS along with pre-emergence herbicide application significantly improved the WCE. While, Birendra *et al*. (2013) stated that two hand weeding at 15 and 30 DAS increased the WCE by 66.7 % and hence proved most effective.

Saeed *et al* (2013) reported that the lowest weed density (51.8 m^{-2}) recorded for hand weeding was statistically at par with black plastic (65.7 m^{2}) and white plastic (71.4 m^{-2}). The variable weeds density among the various weed control treatments can be attributed to their variable weed control efficacy.

Kandasamy (2017) stated that two hand weeding at 20 and 40 DAS resulted in the least weed biomass because of the lowest weed count and less competition throughout the crop duration. Weedy check allowed significantly maximum weed biomass compared to other treatments due to the weed competition throughout the crop duration and resulted in the highest weed count.

Sonawane *et al*. (2014) revealed that two hand weeding at 25 and 40 DAS showed the minimum weed index (14.3 %). The control plots exhibited the maximum weed index (46.5 %) because of uncontrolled weed growth.

Samant *et al*. (2015) mentioned that farmer's practice with two hand weeding at 20 and 40 DAS was found effective and showed the maximum WCE (80.8 %) in maize.

Kamble *et al*. (2015) recorded the lowest weed index (0.70 %) under weed free plots followed by atrazine (50 %) @ 1.2 kg + pendimethalin (50 %) @ 2.5 lit ha^{-1} (1.59 %) under pre-emergence application. The highest weed index was recorded under weedy check i.e. 7.37 %. Rao *et al*. (2016) reported that highest weed index (45.8%) in weedy check.

Gurung *et al.* (2019) reported that the weed control efficiency (97.7, 96.4, 95.9) and (89.6%) were significantly higher in black plastic mulch as compared to all other weeding treatments at 30, 60, 90 DAS and at harvest, respectively. Lowest WI was obtained in black plastic mulch (2.9).

2.3 Economics of various weed management practices of organic sweet corn.

Larbi *et al.* (2002). The economic net returns of plastic mulch and weeds, as mulch are Rs. 39823 and Rs. 38292 respectively as compared to Rs. 21432 ha^{-1} of weedy check.

Reddy and Tyagi (2005) revealed that, due to crop weed competition yield loss ranging from 40 to 80% in maize and weed management practices followed in maize, realized that integrated weed management practices offer not only good weed control but also higher net returns and Benefit: Cost ratio.

Khajanji *et al*. (2006) stated that the two hand weeding at 25 and 45 DAS resulted in higher gross return and net returns in corn.

Gosavi (2006) found that the gross return, net return and B:C ratio of sweet corn were highest under black plastic mulch.

Khajanji *et al*. (2006) reported that hand weeding twice was better in respect of B:C ratio in comparison to weedy check. Malviya and Singh (2007) reported that highest B: C ratio and grain yield of maize after two hand weedings at 20 and 40 DAS was most effective.

Malviya and Singh (2007) reported that the weed free treatment fetched the higher net returns of maize followed by hand weeding twice at 25 and 45 DAS and alachlor 2.0 kg ha^{-1} + HW at 30 DAS + earthing up provided maximum (B:C) benefit cost ratio (1.73) in the 1^{st} year and two hand weeding (1.61) in second year.

Pinjari (2007) informed that the maximum gross return, net return and cost of cultivation was found under plastic mulch and the lowest with weedy check plots during both the years. However, the benefit cost ratio under plastic mulch was comparable with weedy check plots.

Singh *et al*. (2009) reported that the higher grain yield of (37.5 and 36.8 q ha^{-1}) and the maximum net return (Rs 14451 ha^{-1}) was recorded under weed free treatment during 2006 and 2007 respectively, which was at par with hand weeding twice at 20

and 45 DAS. Whereas, highest benefit: cost ratio (2.6) was recorded under two hand weeding at 20 and 45 DAS.

Rao *et al*. (2009) found that hand weeding twice at 15 and 30 DAS gave the maximum gross return (Rs.68445 ha^{-1}) and net return (Rs.50945 ha^{-1}) and B:C ratio (2.9) in maize. Similarly, Sharma and Gautam (2010) found the highest net returns (Rs. 18154 ha^{-1}) and B:C ratio (1.63) with hand weeding twice when as compared to other weed control option.

Arvadiya *et al*. (2012) reported that the application of atrazine 1.0 kg ha^{-1} + one hand weeding at 45 DAS in sweet corn generated the higher net return (88,873 ha^{-1}) and B:C ratio (6.72).

Sanodiya *et al*. (2013) found that the maximum gross returns (Rs.44,054 ha^{-1}) of maize was recorded under the weed free treatment which was closely followed by atrazine 1.0 kg ha^{-1} + hand weeding at 45 DAS.

Mathukia *et al*. (2014) reported that during "*rabi* season" the highest net return (Rs. 77,928 ha^{-1}) and B:C ratio (3.15) were recorded under weed free treatment, followed by hand weeding and inter-cultivation at 15 and 30 DAS and atrazine 0.5 kg ha^{-1} as pre-emergence application + one hand weeding and inter-cultivation at 30 DAS.

Rajput *et al*. (2014) revealed that the maximum and minimum gross return (Rs. 88837) and (Rs.60892 ha^{-1}) were achieved from straw mulch and control treatment and the total cost of cultivation, also followed the same trend. The maximum net return (Rs. 67267 ha^{-1}) was obtained from the straw mulch at 6.2 t ha^{-1} while the minimum net return was obtained with control 0 t ha^{-1} (Rs. 50306).

CHAPTER- III
MATERIAL AND METHOD

This present field experiment **"Effect of different organic weed management practices on growth and yield of sweet corn *(Zea mays* L. *saccharata*)"** was carried out during *Rabi* season of 2020-21. The material used and the method adopted in the experiment are presented in this chapter.

3.1 Location of experimental site

The experiment was conducted in the Instructional cum Research Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) with proper irrigation and drainage facilities during *Rabi*, 2020-21. The institute is located in Raipur, in the central part of Chhattisgarh, i.e. "Chhattisgarh Plains", and lies between 21° 16' N latitude and 81° 26' E longitude at an altitude of 289.56 meters above the mean sea level (MSL)

3.2 Climate

Raipur comes under the Chhattisgarh plains agro climatic sub zone of seventh agro-climatic region of India i.e. Eastern Plateau and Hills. It has dry sub-humid to semi-dry climatic condition. The rainy season starts from June and end in September. The maximum rainfall occurs between July – August. Rainfall is mainly depends on South – West monsoon and least depend on North – East monsoon. Average precipitation of 1074.3 mm is received mostly during month of June to September. The annual rainfall of Raipur is 1305.1 mm while the rainfall is kharif season from June to October is observed to be 1094.1 mm and the rainfall in winter is (from November to January) is 5 mm. Average wind velocity is 8 km hr in the month of June. Summer season begin in March and ended in June. May is the hottest month of summer season with an average high temperature due to Mahanadi basin hot dry storm known as "loo". Winter begins from November and ends in February and coolest month is January with a temperature ranging 9.71 to 17.32 °C. The average temperature of Raipur is 30.23 °C, whereas the minimum and maximum temperature are 12 °C and 40.9 °C respectively.

3.3 Weather condition during crop period

Weather plays significant role in crop growth stages and responsible for achieving higher yield. The main important climatic factors that influence growth, development and ultimately yield of crop during crops period are temperature, rainfall, evaporation, relative humidity and sunshine hours. The meteorological data were recorded at observatory of the Agrometeorology Department, IGKV, Raipur from December to April 2020-21 from sowing to harvesting of the crop are presented in Appendix A. The maximum temperature was recorded 40.3°C and the minimum temperature was 10.3 °C. The crop received total rainfall 15.6 mm during entire growth season. The maximum temperature during crop period varied from 28.2°C in 4th week of January to 40.3°C in 1th week of April while the minimum temperature varied from 10.3 °C in 4th week of December to 23.1°C in 3rd week of April, Wind velocity ranges from 1.8 to 6.15 km ph. The USWB Open pan evaporimeter recorded range of evaporation from 2.87 – 8.14 mm during the entire crop period. The sunshine hours range from 3.21 - 9.52 hours. The weather condition was favorable for the growth and development of the crop throughout entire growth period. The growth and yield of the crop was influenced directly or indirectly with the main climatic factor like temperature, rainfall, evaporation, relative humidity etc.

3.4 Cropping history of the experiment field

The cropping history of the experimental site during last four years is presented in Table 3.1.

Table 3.1 Season wise cropping history of the experimental field

Year	Kharif	Rabi
2016 - 17	Rice	Tomato
2017 - 18	Rice	Tomato
2018 -19	Rice	Tomato
2019 - 20	Rice	Tomato
2020 - 21	Rice	Sweet corn

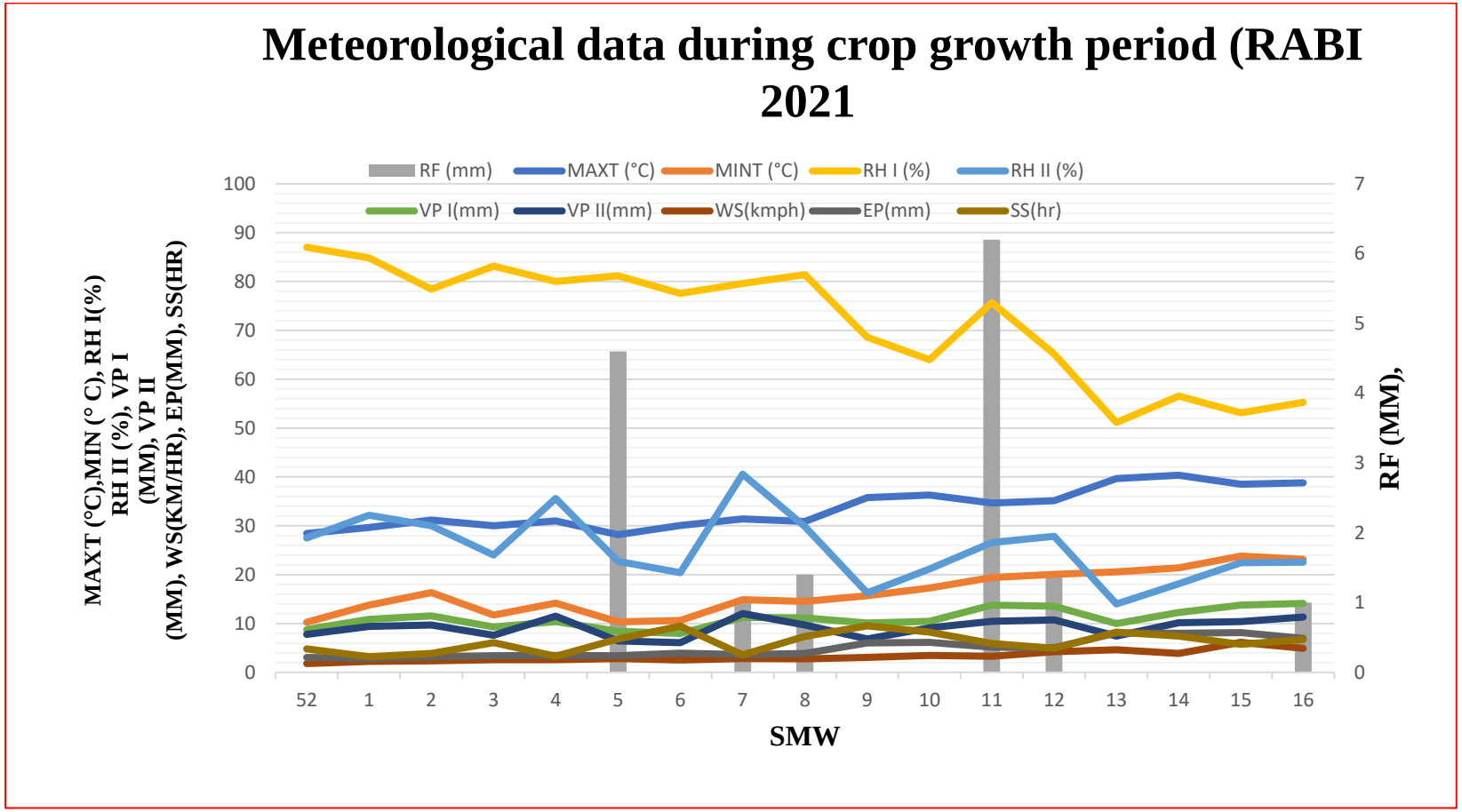


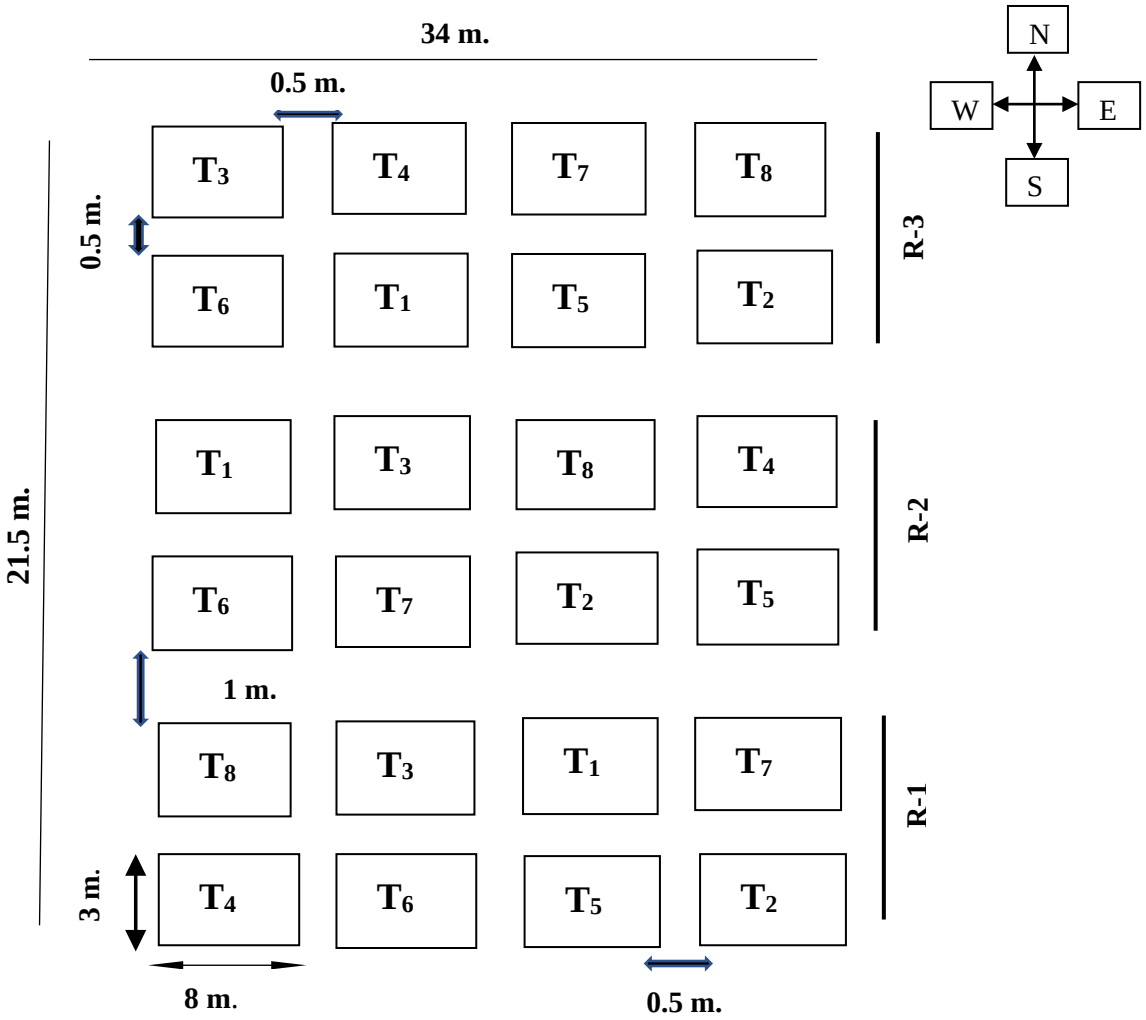
Fig. 3.1: Weekly meteorological observations during crop growth period (From 24 December 2020 to 22 April, 2021

3.5 Soil physio-chemical properties of the experimental site

In order to estimate the Physio-chemical properties of experimental soil of the experimental field, soil samples were randomly collected from different spots of the experimental site at the depth of 0-15 cm with the help of soil auger before sowing of crop for the estimation of available nitrogen, phosphorus, potassium, organic carbon and initial physio-chemical properties of soil. Soil collected from different spots of field was mixed thoroughly and composite sample was drawn by processing and mixing together and then soil sample was taken to the laboratory of Department of Agronomy, IGKV, Raipur for various analyses. The procedures adopted and name of different properties of soil and their values are given in Table 3.2

Table 3.2: Soil physio-chemical properties of the experimental site

S.No.	Particulars	Values	Class	Methods
1.	Sand%	24.06		International pipette method (Black and Evan, 1965)
2.	Silt%	28.05	Clayey soil	International pipette Method (Black and Evan, 1965)
3.	Clay%	46.80		International pipette Method (Black and Evan, 1965)
4.	Available N (Kg ha^{-1})	189.20	Low	Alkaline permagnate method (Subbiah and Asija, 1956)
5.	Available P_2O_5 (Kg ha^{-1})	17.42	Medium	Olsen‟s method (Olsen, 1954)
6.	Available K_2O (Kg ha^{-1})	319.00	High	Flame photometric method (Jackson, 1967)
7	pH	7.1	Neutral	
8.	Organic carbon (%)	0.65	Medium	Titrimetric determination (Walkley and Black,1934)
9.	E.C. (dSm^{-1})	0.31	Normal	Sol bridge method (Black, 1965)



3.6 Experimental details

Design	–	Randomized block design
Treatment	–	8 (Eight)
Replication	–	3 (Three)
Gross plot size	–	8 m x 3 m = 24 m^2
Net plot size	–	7.20 x 2.40 m =17.28 m^2
Spacing	–	40 x 30 cm
		except T_4 (32 x 30 cm)
Date of Sowing	–	31 December 2020
Date of picking	–	1st – 02/04/2021
		2nd - 15/04/2021

Fig 3.2 Layout of Experiment

3.7 Treatment details

	Treatment details
T_1	Hand weeding twice at 20 and 40 DAS
T_2	Black polythene mulch (20 micron thickness)
T_3	Paddy straw mulch 5 tonne ha^{-1}
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS
T_5	Hand hoe twice 20 and 40 DAS
T_6	Live mulching with green gram (incorporation 30 DAS)
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS

3.8 Test crop

The Sweet corn variety Sugar 75 was used in the present field experiment as a test crop which has been developed by *Nongwood seed India pvt ltd, Bengaluru*. It is a hybrid variety of sweet corn possessing cylindrical shape. It matures in 80-85 days, having plant height of 2 meters and is 15-16 % brix of sugar.

3.9 Cultural practices

3.9.1 Field preparation

The field selected was ploughed twice with a tractor drawn cultivator followed by rotavating to provide good tilth. During preparation of layout, the area was cleaned up by removing crop stubbles and weed trash. Minor bunds were made around each plot and replications. The land within the plots was levelled in order to facilitate uniform distribution of irrigation water.

3.9.2 Sowing

The crop was sown on 31 December 2020. Sowing was done manually dropping with one seed per hill in the furrows to a depth of 4 cm with a planting geometry of 40 cm X 30 cm with seed rate 8 kg ha^{-1} in all the treatments except (T_4) where 25% higher plant density was maintained by using 32 cm x 30 cm spacing with seed rate 10 kg ha^{-1}.

3.9.3 Irrigation

Irrigation was given four times throughout the entire crop growth. First irrigation was applied just after seed sowing to ensure proper germination. Second, third and fourth irrigation was applied at knee high, tasseling and silking stages.

3.9.4 Application of organic manure

Before application of organic manures in the field in order to estimate the quantity of organic resources, the content of N, P and K of applied organic sources were determined and then required quantity applied in the experimental field to meet out the required amount of N, P, and K. (80: 50: 30 kg ha^{-1}) as per their content (Table:3.3). 50 % N was applied through FYM, while 25 % was given through vermicompost and rest of 25 % N given through poultry manure. The entire quantity of FYM, 50 % of vermicompost and poultry manure was applied as basal. While remaining 50 % vermicompost was applied in 2 equal splits at Knee-high and pre-tasseling stage of sweet corn.

Table 3.3 Average N, P and K content (%) of different organic sources.

S.N.	Organic Source	N.	P_2O_5	K_2O
1.	FYM	0.53	0.14	0.40
2.	Vermicompost	2.12	0.26	1.53
3.	Poultry manure	2.33	0.61	0.25

Table 3.4: Field operation schedule during the crop season.

S.N.	Cultural schedule		Operation methods	Date
1.	Field preparation	1st	Ploughing	26/12/2020
		2nd	Ploughing	29/12/2020
		3rd	Rotavator	30/12/2020
2.	Layout and minor bunds preparation		Mannually	31/12/2020
3.	Stale seed bed (as per treatment)		Power tiller Weeding of 1 st flush Weeding of 2 nd flush	02/12/2020 19/12/2020 24/12/2020
4.	Sowing and manure application		Manual	31/12/2020
5.	Irrigation			1st 01/01/2021 2nd 18/01/2021 3rd 10/02/2021 4th 06/03/2021
6.	Live mulching with green gram (incorporation 30 DAS)		Manual	02/02/2021
7.	Hand weeding as per treatment		Manual	1st 19/01/2021 2nd 08/02/2021
8.	Mechanical weeding as per treatment		Hand hoe (manually)	1st 19/01/2021 2nd 08/02/2021
9.	Paddy straw mulch as per treatment		Manual	10/01/2021
10.	Black polythene mulch as per treatment		Manual	31/12/2020
11.	Picking of cobs	1st 2 nd	Manually Manually	02/04/2021 15/04/2021

3.9.5 Harvesting

The green cob of sweet corn was manually picked at milky to dough stage. Green cobs were picked up separately from five randomly selected plants from each treatment for recording observations

3.10 Application of weed management treatments

3.10.1 Hand weeding

Hand weeding was scheduled as per the treatment, weed were removed and collected manually from experimental crop by hand.

3.10.2 Black polythene mulch

Black polythene mulch of 20 micron thickness was placed on 30/12/2020 on soil surface of each respective treatment plot before sowing of seed and boundaries were buried in the soil. Before mulching, entire plot was weeded, cleaned. Keeping a 30 cm spacing, plants holes were made with the help of blade for sowing of seeds and mulching was remained till the time of harvest.

3.10.3 Paddy straw mulch

Paddy straw was (5 t ha^{-1}) used for mulching and applied 10/01/2021 as per treatment to the base of the plants manually, maintaining with a thickness of 15-20 cm between two rows of sweet corn and it was remained at three irrigation stages.

3.10.4 Stale seed bed

A stale seed bed technique of weed management help in creating a nearly weed free environment before seed is due to be sown. In these methods weed seeds just below the soil surface are permitted to germinate and then killed prior to planting in 2-3 flushes. Stale seed bed was prepared on 19/12/2020, the weed were killed and incorporated in the soil on 24/12/2020 then 25% higher plant density was maintain in the field.

3.10.5 Mechanical weeding (Hand hoe)

Mechanical weeding was done at 20 and 40 DAS manually with the help of hand hoe in the respective treatments.

3.10.6 Live mulching of green gram

Green gram was taken as intercrop and intercropped between two rows of sweet corn. Its sowing was done on the same day as of the sowing of sweet corn seed. The seed rate of green gram was 15 kg ha^{-1}.

3.10.7 Live mulching (green gram) + intra row hand weeding

Green gram was incorporated in the field 30 days after in this treatment sown as a live mulch and one intra row hand weeding was carried out in the plot. This operation was carried out with the help of field laboures and the seed rate of green gram 15 kg ha^{-1} was used.

3.10.8 Weed mulching + one hand weeding

In-situ mulching of weeds in between rows was carried out 20 DAS and one hand weeding was carried out at 40 DAS manually with the help of field labours.

3.11 Observation recorded

To evaluate the effect of weed management practices on growth and development of sweet corn, observations were recorded during pre and post-harvest conditions of the crop. The data was recorded for different growth and yield parameters Five plants $plot^{-1}$ were selected randomly in the net plot area and tagged for the observations.

3.11.1 Studies on crop

3.11.1.1 Pre harvest observation

3.11.1.1.1 Plant population (m^{-2})

Plant population was recorded per meter row length in each plot during the early growth stage at 20 DAS and at harvest after that the value of plant population was converted into ha^{-1}.

3.11.1.1.2 Plant height (cm)

Five randomly selected plant were used for recording the height of plant It was recorded at 20, 40, 60 DAS and at harvest Height was measured from the ground surface to the fully opened leaf. Mean height was computed by dividing the summations with five.

3.11.1.1.3 Number of leaves plant^{-1}

Total numbers of the fully opened leaves of five tagged plant were counted and averaged to convey as the number of plant^{-1} leaves at 20, 40, 60 DAS and harvest.

3.11.1.1.4 Dry matter accumulation

Dry matter production of sweet corn was noted at 20, 40, and 60, DAS and at harvest. Five plants were selected and cut at ground level from each treatment. The whole shoot portion was kept intact and was dried in sunlight for 12 hours then transferred to an oven at 60 °C till a constant weight was attained. The dry matter by sweet corn was noted at 20, 40, 60 DAS and at harvest. The oven dry weight was recorded for estimating the dry matter accumulation in g plant^{-1}.

3.11.1.2 Post - harvest observations

3.11.1.2.1 Number of cobs plant^{-1}

The numbers of cobs plant^{-1} were counted from five observational plants and mean number of cobs plant^{-1} was worked out. After counting of cobs, the average was worked out to get number of cobs plant^{-1}

3.11.1.2.2 Number of grains cob^{-1}

The number of grains cob^{-1} was counted from the cobs of five randomly selected plants and counted carefully and then the average number of grain cobs^{-1} was worked out.

The number of grains cob^{-1} was calculated as follows

Number of grains cob^{-1} = Number of rows x Number of grains row^{-1}.

3.11.1.2.3 Cob yield (t ha^{-1})

The cobs were removed from plants of net plot of all the treatment separately and weighted to electronic balance and it was recorded in kg per net plot and converted on hectare basis.

3.11.1.2.4 Stover yield (t ha^{-1})

Harvesting was done with the help of sickles manually at 10 cm above the ground level. After the harvesting of green cobs, the remaining stover were tied into bundles separately for each plot and weighing was done. The stover yield from each net plot of the treatment was weighed separately and recorded treatment wise in kg per net plot and finally was converted on hectare basis.

3.12 Computation

3.12.1 Crop

3.12.1.1 Leaf Area

The length of the fully opened leaf lamina was measured from the base to the tip. Leaf breadth was taken at the widest point of the leaf lamina. The product of the leaf length and breadth was multiplied by the factor 0.75 and the sum of all the leaves was expressed as leaf area in cm^2 $plant^{-1}$.

Leaf area was measured by using the formula

Leaf area = Length x Breadth x Factor

3.12.1.2 Leaf area index

The leaf area is important for photosynthesis. Leaf area index is the ratio between leaf area to ground area.

$$LAI = \frac{\text{Leaf area } (cm^2)}{\text{Ground area } (cm^2)}$$

3.12.1.3 Crop growth rate (g plant^{-1} day^{-1})

Crop growth rate was noted between 0-20, 20-40, 40-60 and 60 - at harvest of crop. Crop growth rate was worked out from the dry weight taken at various time intervals. It represents overall growth rate of the crop, and it was measured after fix period of the time irrespective of the previous growth rate. The value was worked out by using the formula suggested by Leopold and Kridermann (1975).

$$\text{Crop growth rate (g plant}^{-1}\text{ day}^{-1}\text{)} = \frac{W_2 - W_1}{T_2 - T_1}$$

Where: -

W_2-W_1 = Difference in oven dry biomass at the time interval

$T_2 - T_1$ = Time interval in days

3.12.1.4 Relative growth rate (g g^{-1} day^{-1})

The increase in dry weight in unit time over the original weight of the plant. It is expressed in g g^{-1} day^{-1}. The observation was recorded at 20-40, 40-60 and 60- at harvest. This formula is given by Lepold and Kriedman (1975):

$$\text{RGR (g g}^{-1}\text{ day-}^{1}\text{)} = \frac{\text{Log}e\ W_2 - \text{Log}e\ W_1}{T_2 - T_1}$$

Where = W_1 and W_2 are the dry weight of the plant T_1 and T_2 is the time

3.13 Studies on weed

3.13.1 Weed flora composition

weed flora of the experimental field of sweet corn was observed before and after treatment application. The important weed species associated with the sweet corn were grouped as monocotyledonous and dicotyledonous weeds as narrow leaf, sedges and broad leaf weeds.

3.13.2 Weed count

The weed count of different weed species was recorded at 20,40 just prior to the application of respective treatment and at 60, DAS and at harvest. Three spots were selected randomly in each plot and for this purpose a quadrate (0.25 m^2) was used. The counting of weeds was done species wise and total population of weeds and then worked out.

3.13.3 Weed dry weight

Production of dry weight by weeds noted at 20, 40,60 DAS and at harvest of sweet corn. Weeds which were present in the quadrate (0.25 m^2) were carefully uprooted. The roots of the weed samples were cut and only the shoot parts were cleaned, sun dried, and finally oven-dried at 65ºC for 48 hours. The dry weight was noted species wise and total dry matter of weeds was registered as well.

3.13.4 Weed control efficiency (%)

Weed control efficiency is the effectiveness of applied treatment for controlling the weeds in comparison to the control plots. Since there is no control plot in the present study and hence the WCE was calculated at (T_6) live mulching with green gram (incorporation at 30 DAS). The following formula was used to work out the weed control efficiency of various treatments as proposed by Mani *et al* (1973)

$$\text{Weed control efficiency (WCE\%)} = \frac{\text{DWC-DWT}}{\text{DWC}} \times 100$$

Where: -

WCE = Weed Control Efficiency

DWC = Dry weight of weeds in control plot or unweeded plot (T_6)

DWT = Dry weight of weeds in treated plot

3.13.5 Weed index (%)

The weed index is percent reduction in grain yield due to the presence of weeds in comparison with weed free situation. It was expressed in % and worked out by using formula given below (Gill and Kumar, 1969).

$$\text{Weed index (\%)} = \frac{\text{Maximum cob yield} - \text{Cob yield from treated plot}}{\text{Maximum cob yield}} \times 100$$

3.14 Economics

3.14.1 Cost of cultivation (Rs ha^{-1})

The cost of cultivation of sweet corn was calculated on the basis of prevailing prices for different inputs. The treatment wise cost of cultivation was calculated by considering the hiring charges of laboures and market value of other inputs like mulches, organic manures etc.

3.14.2 Gross return (Rs ha^{-1})

It was computed from the final green cob yield and stover yield of sweet corn and its prevailing selling rates.

3.14.3 Net return (Rs ha^{-1})

Net returns were worked out by deducting the total cost of cultivation from gross returns.

3.14.4 Benefit cost ratio

The Benefit: Cost ratio was calculated with the help of following formula.

$$\text{Benefit: Cost Ratio} = \frac{\text{Gross Return (Rs. ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs. ha}^{-1}\text{)}}$$

3.15 Statistical analysis

All the data recorded in the study were analyzed statistically. In order to test the significance of data recorded, standard procedure as suggested by Gomez and Gomez (1983) was followed using the technique of analysis of variance for the randomized block design (RBD). The significance in treatment effects were adjudged by calculating critical difference at 5 percent level of significance, wherever, the results were found significant by 'F' test. The mean sum of squares of different characters are given in appendices.

Table 3.5 Skeleton of ANOVA

Sources of Variation	Degree of freedom	Sum of square	Mean sum of square	F calculated value
Replication	(r-1)	RSS	RSS/(r-1) = RMS	RMS/EMS
Treatment	(t-1)	TrSS	TrSS/(t-1) = TMS	TMS/EMS
Error	(r-1) (t-1)	ESS	ESS/(r-1) (t-1) =EMS	
Total	rt-1			

To test the significance of treatment, the calculated value of F was compared with table value of F at 5% level of probability against error degree of freedom.

Where:-

$SEm \pm = \sqrt{EMS/r}$

$CD = \sqrt{(2EMS/r)} \times t_{\text{error d.f at 5\%}}$

$CV (\%) = \sqrt{EMS}/GM \times 100$

R = Number of Replication

T = Number of Treatment

CD.	=	Critical difference
MSS.	=	Mean sum of square
RMS	=	Replication sum of square
SEm ±	=	Standard error of mean
d.f	=	Degree of freedom,
S.S.	=	Sum of square,
CV.	=	Coefficient of variance,
EMS	=	Error mean square
TMS	=	Treatment sum of square
GM	=	General mean

CHAPTER – IV
RESULT AND DISCUSSION

The field experiment entitled "Effect of different organic weed management practices on growth and yield of sweet corn'' (*Zea mays* L. *saccharata*)" was conducted during *rabi season* of 2020-21 at the Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) The results on growth and yield contributing parameters viz. number of cobs, number of grains cob^{-1}, cob yield, stover yield and economics of sweet corn were recorded, analyzed statistically and are presented in this chapter through tables and figures and discussed with suitable reasoning and findings of other research works.

4.1 Pre- harvest observations

4.1.1 Plant population (m^{-2})

The data on initial plant stand at 20 DAS and final plant count at harvest m^{-2} as influenced by different treatments are presented in Table 4.1.

In the initial stage at 20 DAS, a significantly higher plant count of sweet corn was recorded in stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (10.4 m^{-2}) (T_4). While rest of the treatments like hand weeding twice at 20 and 40 DAS (8.33 m^{-2}) (T_1), black polythene mulch (20 micron thickness (8.33 m^{-2}) (T_2), paddy straw mulch 5 t ha^{-1} (8.33 m^{-2}), hand hoe twice 20 and 40 DAS, live mulching with green gram incorporation 30 DAS (8.33 m^{-2}) (T_6) and live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (8.33 m^{-2}) (T_7) of weed management showed similar plant stand and were statistically at par with each other.

At harvest the highest plant population (10.2 m^{-2}) was recorded in stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) followed by black polythene mulch (20 micron thickness) (8.2 m^{-2}) (T_2) and rest of the treatments paddy straw mulch 5 t ha^{-1} (8.0 m^{-2}) (T_3) and hand

weeding at 20 and 40 DAS (8.0 m^{-2}) (T_1), hand hoe twice 20 and 40 DAS (8.0 m^{-2}), live mulching with green gram incorporation 30 DAS (8.0 m^{-2}) (T_6) and live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (8.0 m^{-2}) (T_7) of weed management showed similar plant stand. Reduction in plant population is due to increased weed density and crop-weed competition.

Table 4.1: Plant population of sweet corn as influenced by different organic weed management practices at 20 DAS and At harvest

	Treatment	Plant Population (m^2)	
		20 DAS	**At harvest**
T_1	Hand weeding twice at 20 and 40 DAS	8.3	8.0
T_2	Black polythene mulch (20 micron thickness)	8.3	8.2
T_3	Paddy straw mulch 5 tonne ha^{-1}	8.3	8.0
T_4	Stale seed bed +25% higher plant density) + mulching with paddy straw + one hand weeding at 30 DAS	10.4	10.2
T_5	Hand hoe twice 20 and 40 DAS	8.3	8.0
T_6	Live mulching with green gram (incorporation 30 DAS)	8.3	8.0
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	8.3	8.0
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	8.3	8.0
	SEm ±	**0.32**	**0.12**
	CD (P=0.05)	**0.97**	**0.36**

4.1.2 Plant height (cm)

Plant height of sweet corn was recorded at 20, 40, 60 DAS and at harvest and the data are presented in Table 4.2. Plant height increased with advancement of crop age and the highest magnitude of increase in height was observed between 20 to 40 DAS.

Among the different organic weed management practices, the maximum plant height (19.1, 76.7, 158.1 and 185.0 cm) was recorded at 20, 40, 60 DAS and at harvest respectively under the black polythene mulch (T_2). However, at 40 DAS it was found at par with treatment: stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (72.6 cm) (T_4), paddy straw mulch 5 t ha^{-1} (71.5 cm) (T_3) and hand weeding at 20 and 40 DAS (71.5) (T_1). At 60 DAS, it was found at par with treatment: stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) (155.0 cm).

Table 4.2: Plant height (cm) of sweet corn as influenced by different organic weed management practices.

	Treatment	Plant height (cm)			
		20 DAS	**40 DAS**	**60 DAS**	**At harvest**
T_1	Hand weeding twice at 20 and 40 DAS	17.1	71.5	139.8	173.8
T_2	Black polythene mulch (20 micron thickness)	19.1	76.7	158.1	185.0
T_3	Paddy straw mulch 5 tonne ha^{-1}	17.6	71.5	144.3	174.0
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	18.3	72.6	155.0	177.8
T_5	Hand hoe twice 20 & 40 DAS	18.0	63.2	135.1	172.7
T_6	Live mulching with green gram (incorporation 30 DAS)	16.6	45.3	128.7	162.7
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	17.6	58.1	133.1	170.9
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	17.5	57.1	131.0	167.6
	SEm ±	**0.28**	**1.57**	**1.10**	**1.29**
	CD (P=0.05)	**0.86**	**4.76**	**3.33**	**3.92**

These results might be due to that the plastic mulch promoted early vigorous growth of the plant as it was highly effective in moisture conservation and in alleviating sub optimal temperature condition (Yi *et al*.2011). Rest of the weed

management practices were significantly inferior over this treatment. Live mulching with green gram (incorporation 30 DAS) (T_6) produced significantly lower plant height at all the observational dates as compared to other treatments indicating that weeds reduced the plant height due to competition for growth resources.

4.1.3 No. of leave plant^{-1}

The periodical data on number of leaves of sweet corn as influenced by different weed management practices are presented in Table 4.3. The number of leaves per plant was increased up to 60 DAS. The number of leaves per plant was not affected significantly at 20 DAS.

Table 4.3 Number of leaves plant^{-1} of sweet corn as influenced by different organic weed management practices.

	Treatment	No. of leave plant^{-1}			
		20 DAS	**40 DAS**	**60 DAS**	**At harvest**
T_1	Hand weeding twice at 20 and 40 DAS	3.8	7.4	9.5	8.8
T_2	Black polythene mulch (20 micron thickness)	4.4	8.2	11.2	9.4
T_3	Paddy straw mulch 5 tonne ha^{-1}	4.1	7.4	9.9	9.0
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	4.3	7.6	9.8	9.2
T_5	Hand hoe twice 20 and 40 DAS	3.8	7.2	9.5	7.9
T_6	Live mulching with green gram (incorporation 30 DAS)	3.8	6.8	8.3	7.4
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	4.1	6.9	9.1	7.8
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	4.4	7.3	9.8	8.0
	SEm ±	**0.17**	**0.24**	**0.20**	**0.19**
	CD (P=0.05)	**NS**	**0.74**	**0.60**	**0.58**

The highest number of leaves (8.2 and 11.2 plant^{-1}) at 40 and 60 DAS was observed respectively under black polythene mulch (20 micron thickness) (T_2) however at 40 DAS, it was at par with stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS 7.6 (T_4). The lowest number of leaves per plant at all the observation was found under live mulching with green gram (incorporation 30 DAS).

4.1.4 Dry matter accumulation (g plant^{-1})

The data related to dry matter accumulation plant^{-1} was recorded at 20, 40, 60 DAS and at harvest are presented in Table 4.4. The results revealed that dry matter accumulation increased with the advancement of crop age till harvest.

Table 4.4: Dry matter accumulation (g plant^{-1}) of sweet corn as influenced by different organic weed management practices.

	Treatment	Dry matter accumulation (g plant^{-1})			
		20 DAS	40 DAS	60 DAS	At harvest
T_1	Hand weeding twice at 20 and 40 DAS	2.65	18.61	84.07	141.89
T_2	Black polythene mulch (20 micron thickness)	4.14	25.00	86.04	152.90
T_3	Paddy straw mulch 5 tonne ha^{-1}	3.34	22.26	83.54	144.62
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	3.79	23.87	84.31	146.28
T_5	Hand hoe twice 20 and 40 DAS	2.61	17.29	62.90	139.96
T_6	Live mulching with green gram (incorporation 30 DAS)	2.39	11.06	53.72	125.39
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	2.43	16.39	63.62	129.29
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	2.38	16.63	66.18	140.19
	SEm ±	**0.09**	**0.37**	**0.83**	**0.89**
	CD (P=0.05)	**0.28**	**1.14**	**2.53**	**2.70**

At 20, 40, 60 DAS and at harvest, significantly the highest dry matter accumulation plant^{-1} (4.14, 25.00, 86.04 and 152.90 g plant^{-1}) was recorded under black polythene mulch (20 micron thickness) treatment. However, at 60 DAS, stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (84.31 g plant^{-1}), paddy straw mulch 5 t ha^{-1} (83.54 g plant^{-1}) and hand weeding at 20 and 40 DAS (84.07 g plant^{-1}) was found at par to that of black polythene mulch treatment.

Significantly the lowest dry matter was observed under (T_6) i.e. live mulching with of green gram (incorporation 30 DAS) as compared to other treatments during all the stages of observation. Since black polythene mulch (20 micron thickness) had effectively controlled weeds, hence it resulted in the minimum crop weed competition which ultimately produced the highest dry matter accumulation. Further as the dry matter production is largely a function of photosynthetic surface which has also influenced more under black polythene mulch (20 micron thickness) (T_2) resulting in higher dry matter accumulation. As a result of the minimum crop weed competition, height of plants and leaves were at higher side which resulted in higher dry matter production. These results are found to be in close conformity with Ahmed *et al*. (2013)

4.1.5 Leaf area (cm^2 plant^{-1})

Leaf area (cm^2 plant^{-1}) was computed it 20, 40, 60 DAS and at harvest and are presented in Table 4.5 In general, with increase in number of leaves per plant, leaf area was also increased remarkably up to 60 DAS and decline afterwards till harvest of the crop.

Among the various weed management practices, the highest leaf area recorded at 20, 40, 60 DAS and at harvest was 204.0, 928.1, 1430.9 and 1217.2 cm^2 respectively in the treatment where black polythene mulch (20 micron thickness) was used. However, it was found at par with treatments of paddy straw mulch 5 t ha^{-1} (T_3) and stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) at observational stages of 40 DAS to at harvest.

On the contrary, the lowest leaf area of 181.0, 619.5, 815.3 and 769.0 cm^2 respectively was noticed in live mulching with green gram (incorporation 30 DAS) at different growth stages.

Table 4.5: Leaf area plant^{-1} of sweet corn as as influenced by different organic weed management practices

	Treatment	Leaf area (cm^2 plant^{-1})			
		20 DAS	40 DAS	60 DAS	At harvest
T_1	Hand weeding twice at 20 and 40 DAS	192.5	909.0	1168.0	1011.4
T_2	Black polythene mulch (20 micron thickness)	204.0	928.1	1430.9	1217.2
T_3	Paddy straw mulch 5 tonne ha^{-1}	197.1	909.3	1360.4	1104.5
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	198.5	925.8	1360.4	1105.4
T_5	Hand hoe twice 20 and 40 DAS	194.9	794.7	1145.3	991.1
T_6	Live mulching with green gram (incorporation 30 DAS)	181.0	619.5	815.3	769.0
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	189.8	764.1	1009.5	930.8
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	190.4	803.5	1236.0	994.8
	SE m±	**2.8**	**6.3**	**23.9**	**14.7**
	CD (P=0.05)	**8.5**	**19.2**	**72.5**	**44.6**

4.1.6 Leaf area index (LAI)

Leaf area index is correlated with leaf area and it was also significantly influenced by the application of different weed management practices (Table 4.6). The highest LAI was recorded in stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) and black polythene mulch 20 micron thickness (T_2) over rest of the treatment and found superior over

all the other weed management practices. The lowest LAI was recorded in live mulching with green gram (incorporation 30 DAS). LAI at 60 DAS improved considerably and recorded significantly higher under stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) and black polythene mulch (20 micron thickness) as compared to paddy straw mulch 5 t ha^{-1} and no mulch treatment. The higher LAI in the black polythene mulch might be attributed to their weed control effect, thus provided conducive environment which also accelerated vegetative growth in plastic mulches (Gul *et al*. 2009).

Table 4.6: Leaf area index of sweet corn as influenced by different organic weed management practices

	Treatment	Leaf area index			
		20 DAS	**40 DAS**	**60 DAS**	**At harvest**
T_1	Hand weeding twice at 20 and 40 DAS	0.16	0.76	0.97	0.84
T_2	Black polythene mulch (20 micron thickness)	0.17	0.77	1.19	1.01
T_3	Paddy straw mulch 5 tonne ha^{-1}	0.16	0.76	1.13	0.92
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	0.20	0.96	1.42	1.10
T_5	Hand hoe twice 20 and 40 DAS	0.16	0.66	0.95	0.83
T_6	Live mulching with green gram (incorporation 30 DAS)	0.15	0.52	0.68	0.64
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	0.16	0.64	0.84	0.78
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	0.16	0.67	1.03	0.83
	SE m±	**0.00**	**0.01**	**0.02**	**0.01**
	CD (P=0.05)	**0.01**	**0.02**	**0.06**	**0.04**

4.1.7 Crop growth rate

The data depicted graphically in Fig. 4.1 shows that the weed management practices significantly increased the crop growth rate (CGR) of sweet corn (g plant^{-1}day^{-1}). Between 0 to 20 DAS, the growth was significantly affected by the weed management practices. The highest and lowest CGR at 0 to 20 DAS was recorded in black polythene mulch (20 micron thickness) (T_2) and live mulching with green gram (incorporation 30 DAS) (T_6) respectively.

Between 20 to 40 DAS, the CGR was increased for all the weed management practices. The maximum CGR was recorded in black polythene mulch (20 micron thickness) (T_2) followed by stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4), hand weeding at 20 and 40 DAS (T_1) and paddy straw mulch 5 t ha^{-1} (T_3) While, the lowest CGR was computed in live mulching with green gram (incorporation 30 DAS) (T_6).

Between 40 to 60 DAS, higher CGR was obtained in black polythene mulch (20 micron thickness) (T_2) and stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4), paddy straw mulch 5 t ha^{-1} (T_3) hand weeding at 20 and 40 DAS (T_1) while, the lowest CGR was computed in live mulching with green gram (incorporation 30 DAS) (T_6) and live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (T_7). The same pattern was also noticed at harvest. From 40 DAS on words, the CGR increased remarkably and the highest CGR was observed between 60 – at harvest under black polythene mulch (20 micron thickness) treatment which was found statistically similar with stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) and paddy straw mulch 5 t ha^{-1} (T_3). Growth of plants significantly enhanced under the plots where mulch applied over no mulched plots was also reported by Rana et al. (2006). Loss of growth due to uncontrolled weed growth during critical growth period was observed by Porwal (2000).

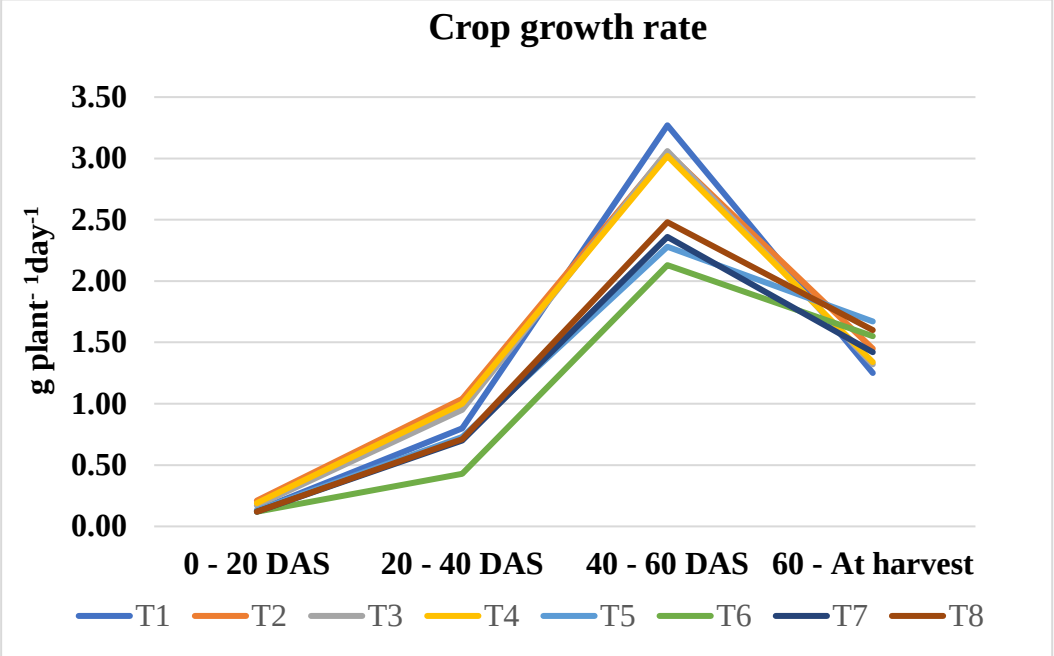


Fig. 4.1 Crop growth rate of sweet corn as influenced by different organic weed management practices at different time interval.

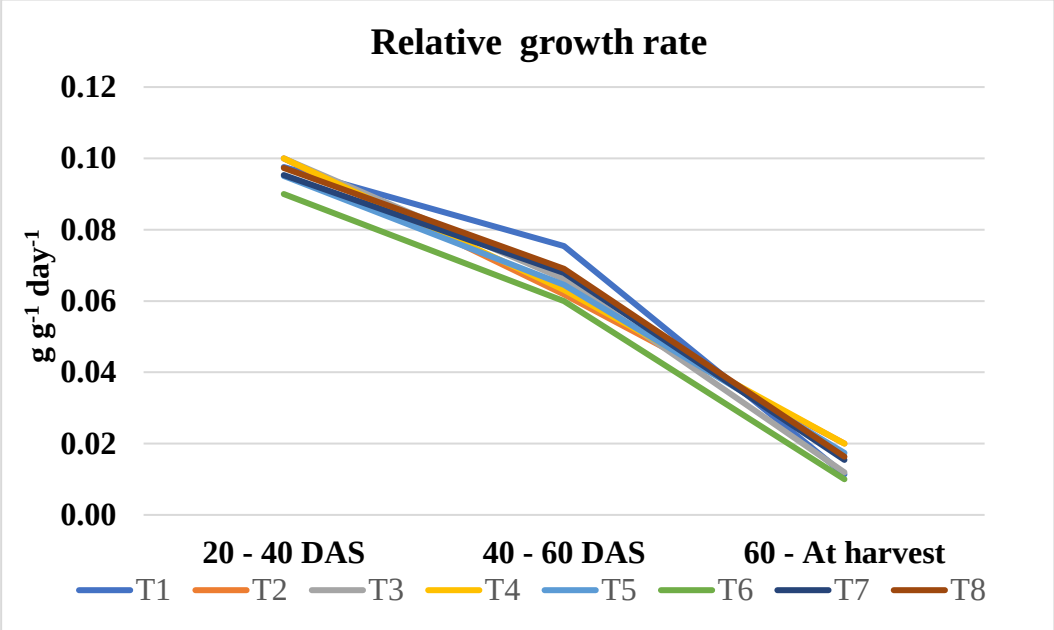


Fig 4.2 Relative growth rate of sweet corn as influenced by different organic weed management practices at different time interval.

4.1.8 Relative growth rate

The data represented graphically in Fig. 4.2 shows that the weed management practices significantly increased the relative growth rate (RGR) of sweet corn (g g^{-1} day^{-1}). Between 20 to 40 DAS the growth was significantly affected by the weed management practices. The highest and lowest RGR at 20 to 40 DAS was recorded in hand weeding twice at 20 and 40 DAS (T_1) and paddy straw mulch 5 t ha^{-1} (T_3) respectively.

Between 0 to 40 DAS, the RGR was increased for all the weed management practices. The maximum RGR was recorded in hand weeding twice 20 and 40 DAS (T_1) followed by paddy straw mulch 5 t ha^{-1} (T_3), live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (T_7) and the lowest in hand hoe twice 20 and 40 DAS (T_5).

The highest RGR was observed between 60 DAS and at harvest under black polythene mulch (20 micron thickness) (T_2) followed by stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4), live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (T_7) and weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS.

4.2 Post - harvest observations

4.2.1 Number of cobs $plant^{-1}$

The number of green cobs $plant^{-1}$ significantly influenced by different weed management practices (Table 4.7). Higher number of cobs (2.07) $plant^{-1}$ was produced by black polythene mulch 20 micron thickness (T_2) which was at par with paddy straw mulch 5 tonne ha^{-1} (T_3) and stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) and hand weeding twice 20 and 40 DAS (T_1). All the aforesaid weed management practices were effective to control weeds which resulted in least crop-weed competition and vigorous growth of plants producing more cobs $plant^{-1}$. Whereas live mulching with

green gram (incorporation 30 DAS) produced significantly the minimum number of cobs plant^{-1} (1.27 cob plant^{-1}). The results are in close conformity to that reported by Mandal *et al*. (2004) and Chopra and Angiras (2008).

4.2.2 Number of grains cob^{-1}

The number of grains cob^{-1} was significantly superior in (T_2) viz; black polythene mulch (483) which was comparable with (T_3) : paddy straw mulch 5 tone ha^{-1} (449), (T_4) stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (440), (T_1) one hand weeding twice at 20 and 40 DAS (423) and (T_5) : hand hoe twice 20 and 40 DAS (417). The lowest number of grains cob^{-1} (367) was recorded in (T_6): live mulching with green gram (incorporation 30 DAS). These results are also in consonance with Bhatt *et al*. (2004). Dastfal *et al.,* (1999) reported that the highest number of grain cob^{-1} in hand

Table 4.7 No. of cobs plant^{-1} and No. of grains cob^{-1} and of sweet corn as influenced by different organic weed management practices.

	Treatment	No. of cobs plant^{-1}	No. of grains cob^{-1}
T_1	Hand weeding twice at 20 and 40 DAS	1.83	423
T_2	Black polythene mulch (20 micron thickness)	2.07	483
T_3	Paddy straw mulch 5 tonne ha^{-1}	1.93	449
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	1.90	440
T_5	Hand hoe twice 20 and 40 DAS	1.70	417
T_6	Live mulching with green gram (incorporation 30 DAS)	1.27	367
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	1.57	405
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	1.63	409
	SEm ±	**0.09**	**22**
	CD (P=0.05)	**0.26**	**67**

weeding and black polythene mulch could be attributed to enhanced soil temperature, better conservation of soil moisture and efficient control of weeds which helped to produced more number of grains. The lowest grains cob^{-1} in living mulch treatments might be due to higher weed infestation and increased interspecific competition.

4.3 Yield

4.3.1 Cob yield (t ha^{-1})

The data presented in Table 4.8 indicate that the weed management practices had significant effect on green cob yield of sweet corn under organic farming system. Significantly the highest green cob yield (7.42 t ha^{-1}) of sweet corn was recorded in black polythene mulch (20 micron thickness) (T_2). It was found at par with the treatment having stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (6.80 t ha^{-1}) (T_4). Although grain yield in other weed management practices was significantly lower than black polythene mulch (20 micron thickness) treatment but higher than live mulching with green gram (incorporation 30 DAS) (T_6).

The different growth and yield parameters *viz*. dry matter accumulation, number of cobs plant^{-1}, number of grains cob^{-1}, green cob yield (t ha^{-1}) and stover yield (t ha^{-1}) was remarkably superior in black polythene mulch (20 micron thickness) Due to the lack of light under the black plastic mulch, photosynthesis could not be done and weeds could not grow. Therefore, the plants have had greater access to water and nutrients. (Aruna *et al.* 2007). Treatments like stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4), paddy straw mulch 5 tone ha^{-1} (T_3), hand weeding twice at 20 and 40 DAS (T_1) and Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS (T_8) performed similar to that of (T_2) the best contributing treatment mentioned above. These treatments proved to be better in resulting higher yield. The possible reason for better yield contributing characters and significantly higher green cob yield compared to other treatments like hand hoe

twice 20 and 40 DAS (T_5), live mulching with green gram (incorporation 30 DAS) (T_6) and live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (T_7), might be due to good weed management by the treatments which reduced the weed density and weed dry weight per unit area and allowed crop to grow properly and utilize all the essential growth factors like space, nutrient, water and solar radiation for its growth and development. Similar finding was also reportedly (Ahmed *et al.*2013). In polythene mulched plots, the soil temperature was 6-8 °C higher and might be due to its effects on soil temperature, soil moisture and weed suppression as compared to other plots. The resulted modification in crop ecology produced 48.8 % and 44 % more grain yield with polythene mulch (T_2) and straw mulch (T_3) respectively as compared to live mulching with green gram (incorporation 30 DAS) treatments because polythene sheets or straw mulch create good environment for plant growth. The plastic mulch covered the soil, prevented early weed recruitment through acting as physical barrier and through solarization effect (Ogunyemi *et al;* 2007) and resulted in lower weed index. Although grain yield in other weed management practices was significantly lower than plastic mulch treatments but higher than in live mulching with green gram (incorporation 30 DAS) (T_6) treatment. Stale seed bed where one or two flushes of weeds are destroyed before sowing of sweet corn. This is achieved by soaking a well prepared field with irrigation and allowing the weeds to germinate. These weeds are controlled by weeding then sowing of crop. Here the advantage is the crop is germinated in weed free environment. In this way, weed seed bank is minimized. Similarly, the maximum dry matter accumulation of crop recorded in black polythene mulch (T_2) and stale seed bed treatment with the aid of using hand weeding (T_4) provided sufficient food material for producing higher number of grains cob^{-1} and resulted in massive cobs compared to rest of the treatments.

Similarly stale seed bed can be an effective method of decreasing the density of annual weeds which gave a favorable for sweet corn as it has been demonstrated in many studies including weed control in maize production system (Leblanc and Cloutier 1996).

Table 4.8: Green cob yield, stover yield and weed index of sweet corn as influenced by different organic weed management practices.

	Treatment	Cob yield (t ha^{-1})	Stover yield (t ha^{-1})	Weed index (%)
T_1	Hand weeding twice at 20 and 40 DAS	6.20	14.16	16.44
T_2	Black polythene mulch (20 micron thickness)	7.42	16.17	-
T_3	Paddy straw mulch 5 tonne ha^{-1}	6.46	14.89	12.93
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	6.80	15.39	8.35
T_5	Hand hoe twice 20 and 40 DAS	5.21	13.34	29.78
T_6	Live mulching with green gram (incorporation 30 DAS)	3.80	11.74	48.78
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	5.01	14.31	32.47
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	5.47	15.21	26.28
	SEm ±	**0.28**	**0.61**	
	CD (P=0.05)	**0.85**	**1.86**	

4.3.2 Stover yield (t ha^{-1})

The data on mean stover yield of sweet corn as affected by different weed management practices revealed that the black polythene mulch (20 micron thickness) gave the significantly higher stover yield (16.17 t ha^{-1}) (T_2) which was found at par with stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (15.39 t ha^{-1}) (T_4), paddy straw mulch 5 t ha^{-1} (14.89 t ha^{-1}) (T_3). The lowest stover yield recorded in live mulching with green gram (incorporation 30 DAS) (11.74 t ha^{-1}) (T_6).

4.3.3 Weed index (%)

Weed index represents the reduction in crop yield due to the presence of weeds in comparison to weed free plot. Weed index was calculated at harvest and it was significantly influenced by different weed management practices (Table 4.8).

Among the different weed management practices, the highest weed index (48.78 %) was recorded in live mulching with green gram incorporation 30 DAS (T_6) followed by live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (32.47%) (T_7) and hand hoe twice 20 and 40 DAS (29.78%) (T_5) respectively. The lowest weed index was recorded in black polythene mulch 20 micron thickness (T_2).

4.4 Weed studies

4.4.1 Weed flora

The data on composition of weed flora in different treatments at 20, 40, 60 DAS and at harvest are presented in Table 4.9.

Medicago denticulata, *Alternanthera sessilis*, *Chenopodium album* and *Echinochloa colona* were the major weeds observed in the experimental field while the density of *Cyperus spp* and *Cynodon dactylon* observed lesser and grouped as other weeds.

Table 4.9 Weed flora of experimental field

S.no.	Dominant weed	Family	S.no.	Other weeds	Family
1.	*Medicago denticulata*	Fabaceae	**5.**	*Cynodon dactylon*	Poaceae
2.	*Echinochloa colona*	Poaceae	**6.**	*Spilanthes acmella*	Asteraceae
3.	*Alternanthera sessilis*	Amaranthaceae	**7.**	*Cyperus spp.*	Cyperaceae
4.	*Chenopodium album*	Amaranthaceae			

4.4.2 Weed count

Weed count m^{-2} in different treatments was recorded at 20, 40, 60 DAS and at harvest are presented in Table 4.10, 4.11, 4.12, 4.13. Weed count was significantly influenced by various weed management practices.

At 20 DAS among various weed management practices, the black polythene mulch (T_2) treatment was found superior over all the treatment as there were lowest (1.33 m^{-2}) weeds in this treatment. Black polythene mulch (20 micron thickness) hindered the germination of weed seeds by increasing the surface temperature as compared to other weed management practices. The effectiveness of black polythene sheet as mulching material in restricting weed growth has also been reported by Shah *et al*. (2014). At 20 DAS, next in order of the lowest count of *Medicago denticulata, Echinochloa colona, Chenopodium album, Alternanthera sessilis* and others weeds were observed in stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) which was closely followed by mulching with paddy straw mulch 5 t ha^{-1} (T_3). Stale seed bed was more effective in reducing the weed count as compared to other. (Singh 2013). The higher density of all these weeds was recorded under weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS treatments.

At 40 DAS, among the various weed management practices, the lowest count of *Medicago denticulata, Echinochloa colona, Chenopodium album Alternanthera sessilis,* other weeds and total weed count was observed in black polythene mulch (T_2). Infact no count of *Echinochloa colona, Chenopodium album, Alternanthera sessilis* and collectively other weeds at 20 DAS and zero count of *Echinochloa colona, Chenopodium album, Alternanthera sessilis* and other weeds at 40 DAS was observed in the black polythene mulch (T_2) It was closely followed by stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4). However, density of *Echinochloa colona, Chenopodium album, Alternanthera sessilis* and other weed was found at par to that of hand weeding twice at 20 and 40 DAS (T_1) and stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4). Leblanc and Cloutier (1996)

also demonstrated that stale seed bed could be an effective method of decreasing the density of annual weeds.

On the other hand, the highest density of these weeds and total weed density were observed in hand hoe twice 20 and 40 DAS (T_5) and weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS (T_8).

As regards to total weed count m^{-2}, the significantly lower count was figured in stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) at 40 DAS. Whereas, highest total weed density was seen in weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS (T_8).

Weed count data recorded at 60 DAS (Table 4.12) revealed that among various weed management practices the lowest count of *Medicago denticulata*, *Echinochloa colona* were observed under black polythene mulch, whereas, *Alternanthera sessilis*, *Chenopodium album* and other weeds was observed the lowest in hand weeding twice 20 and 40 DAS (T_1) and stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4). On the other hand, the highest weed count of major weeds and total weed count was recorded in live mulching with green gram (incorporation 30 DAS) (T_6).

Observations recorded at harvest on weed count of different weeds and total weeds indicated that the weed management practices had significant impact on weed density in organically grown sweet corn. Among various weed management practices, the black polythene mulch (20 micron thickness) (T_2) treatment was superior over all the treatments in respect of the lowest weed count of *Medicago denticulata* (3.67 m^{-2}) and *Echinochloa colona* (2.00 m^{-2}) was found in this treatment. While, among rest of the other treatments, the highest population of *Medicago denticulata and Echinochloa colona, Chenopodium album, Alternanthera sessilis and other weeds* was observed in live mulching with green gram (incorporation 30 DAS) (T_6), and the lowest density of these weeds were observed in stale seed bed + 25% higher plant density + mulching with paddy straw + one

hand weeding at 30 DAS (T_4) and followed by hand weeding twice 20 and 40 DAS, paddy straw mulch 5 t ha^{-1} (Table 4.13). The season long reduced density of weeds in plastic mulch might be due to the sensitivity of the most of the weed seeds to light. The fact that polythene sheet mulch acts as a barrier between sunlight and soil which further leads to a reduction in the weed growth under the mulches. Eventually, these weed seeds did not germinate under the plastic mulch so ultimately caused a reduction in population (Mahajan *et al*. 2007)

Table 4.10: Weed count (m^{-2}) in sweet corn as influenced by different organic weed management practices at 20 DAS

	Treatment	Weed count (no. m^{-2})					
		Medicago denticulata	***Echinochloa colona***	***Chenopodium album***	***Alternanthera sessilis***	**Others**	**Total**
T_1	Hand weeding twice at 20 and 40 DAS	7.22 (51.67)	5.61 (31.00)	4.64 (21.00)	2.34 (5.00)	2.48 (5.67)	10.72 (114.33)
T_2	Black polythene mulch (20 micron thickness)	1.34 (1.33)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	1.34 (1.33)
T_3	Paddy straw mulch 5 tonne ha^{-1}	3.03 (8.67)	2.47 (5.67)	1.74 (2.67)	1.68 (2.33)	1.68 (2.33)	4.70 (21.67)
T_4	Stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	2.48 (5.67)	1.90 (3.33)	1.86 (3.00)	1.44 (1.67)	1.46 (1.67)	3.97 (15.33)
T_5	Hand hoe twice 20 and 40 DAS	7.24 (52.00)	5.73 (32.3)	4.88 (23.33)	2.48 (5.67)	2.85 (7.67)	11.02 (121.00)
T_6	Live mulching with green gram (incorporation 30 DAS)	7.20 (51.33)	4.30 (18.0)	4.52 (20.00)	2.34 (5.00)	2.47 (5.67)	10.02 (100.00)
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	7.22 (51.67)	4.18 (17.00)	4.41 (19.00)	2.20 (4.33)	2.41 (5.33)	9.89 (97.33)
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	7.29 (52.67)	5.64 (31.33)	4.74 (22.00)	2.48 (5.67)	2.80 (7.33)	10.93 (119.00)
	SEm ±	**0.11**	**0.13**	**0.16**	**0.13**	**0.12**	**0.12**
	CD (P=0.05)	**0.34**	**0.41**	**0.48**	**0.39**	**0.35**	**0.38**

Note* Data in parenthesis are pre transformed original values, which were transformed to $\sqrt{(x + 0.5)}$ and analysed statistically

Table 4.11: Weed count (m^{-2}) in sweet corn as influenced by different organic weed management practices at 40 DAS

	Treatment	Weed count (no. m^{-2})					
		Medicago denticulata	***Echinochloa colona***	***Chenopodium album***	***Alternanthera sessilis***	**Others**	**Total**
T_1	Hand weeding twice at 20 and 40 DAS	2.92 (8.00)	1.87 (3.00)	1.68 (2.33)	1.34 (1.33)	1.95 (3.33)	4.30 (18.00)
T_2	Black polythene mulch (20 micron thickness)	1.95 (3.33)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	1.95 (3.33)
T_3	Paddy straw mulch 5 tonne ha^{-1}	3.29 (10.33)	2.68 (6.67)	2.11 (4.00)	1.46 (1.67)	2.11 (4.00)	5.21 (26.67)
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	2.68 (6.67)	1.68 (2.33)	1.34 (1.33)	0.71 (0.00)	0.71 (0.00)	3.29 (10.33)
T_5	Hand hoe twice 20 and 40 DAS	3.94 (15.00)	3.58 (12.33)	3.84 (14.33)	1.56 (2.00)	2.86 (7.67)	7.20 (51.33)
T_6	Live mulching with green gram (incorporation 30 DAS)	3.53 (12.00)	3.81 (14.00)	3.49 (11.67)	1.95 (3.33)	2.41 (5.33)	6.84 (46.33)
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	3.34 (10.67)	2.74 (7.00)	2.41 (5.33)	1.68 (2.33)	2.04 (3.67)	5.43 (29.00)
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	3.85 (14.33)	3.67 (13.00)	3.53 (12.00)	1.34 (1.33)	2.54 (6.00)	6.87 (46.67)
	SEm ±	**0.10**	**0.11**	**0.18**	**0.17**	**0.09**	**0.16**
	CD (P=0.05)	**0.30**	**0.36**	**0.55**	**0.51**	**0.28**	**0.48**

Note* Data in parenthesis are pre transformed original values, which were transformed to $\sqrt{(x + 0.5)}$ and analysed statistically

Table 4.12: Weed count (m^{-2}) in sweet corn as influenced by different organic weed management practices at 60 DAS

	Treatment	Weed count (no. m^{-2})					
		Medicago denticulata	***Echinochloa colona***	***Chenopodium album***	***Alternanthera sessilis***	**Others**	**Total**
T_1	Hand weeding twice at 20 and 40 DAS	2.48 (5.67)	1.77 (2.67)	1.68 (2.33)	1.22 (1.00)	1.58 (2.00)	3.76 (13.67)
T_2	Black polythene mulch (20 micron thickness)	2.04 (3.67)	1.22 (1.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	2.48 (2.27)
T_3	Paddy straw mulch 5 tonne ha^{-1}	3.34 (10.67)	2.73 (7.00)	2.27 (4.67)	1.68 (2.33)	1.68 (2.33)	5.24 (27.00)
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	3.03 (8.67)	1.87 (3.00)	1.46 (1.67)	1.58 (2.00)	1.58 (2.00)	4.22 (17.33)
T_5	Hand hoe twice 20 and 40 DAS	3.44 (11.33)	3.34 (10.67)	3.03 (8.67)	1.77 (2.67)	2.04 (3.67)	6.12 (37.00)
T_6	Live mulching with green gram (incorporation 30 DAS)	4.67 (21.33)	4.45 (19.33)	3.54 (12.00)	2.97 (8.33)	2.68 (6.67)	8.26 (67.67)
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	3.72 (13.33)	3.89 (14.67)	2.86 (7.67)	2.68 (6.67)	2.41 (5.33)	6.94 (47.67)
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	3.13 (9.33)	2.92 (8.00)	2.61 (6.33)	1.34 (1.33)	1.95 (3.33)	5.37 (28.33)
	SEm ±	**0.14**	**0.08**	**0.09**	**0.08**	**0.13**	**0.08**
	CD (P=0.05)	**0.42**	**0.25**	**0.28**	**0.23**	**0.40**	**0.24**

Note* Data in parenthesis are pre transformed original values, which were transformed to $\sqrt{(x + 0.5)}$ and analysed statistically

Table 4.13: Weed count (m^{-2}) in sweet corn as influenced by different organic weed management practices at harvest

	Treatment	Weed count (no. m^{-2})					
		Medicago denticulata	***Echinochloa colona***	***Chenopodium album***	***Alternanthera sessilis***	**Others**	**Total**
T_1	Hand weeding twice at 20 and 40 DAS	3.98 (15.33)	2.97 (8.33)	2.48 (5.67)	1.68 (2.33)	2.04 (3.67)	5.99 (35.33)
T_2	Black polythene mulch (20 micron thickness)	2.04 (3.67)	1.58 (2.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	2.48 (5.67)
T_3	Paddy straw mulch 5 tonne ha^{-1}	3.94 (15.00)	2.79 (7.33)	2.41 (5.33)	1.77 (2.67)	2.41 (5.33)	6.01 (35.67)
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	3.08 (9.00)	2.61 (6.33)	2.04 (3.67)	1.68 (2.33)	2.04 (3.67)	5.05 (25.00)
T_5	Hand hoe twice 20 and 40 DAS	4.88 (23.33)	3.49 (11.67)	3.29 (10.33)	1.95 (3.33)	2.41 (5.33)	7.38 (54.00)
T_6	Live mulching with green gram (incorporation 30 DAS)	5.55 (30.33)	4.98 (24.33)	3.58 (12.33)	2.18 (4.33)	3.29 (10.33)	9.06 (81.67)
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	5.12 (25.67)	4.53 (20.00)	3.49 (11.67)	2.11 (4.00)	2.97 (8.33)	8.38 (69.67)
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	4.53 (20.00)	3.39 (11.00)	2.92 (8.00)	1.87 (3.00)	2.27 (4.67)	6.87 (46.67)
	SEm ±	**0.09**	**0.06**	**0.08**	**0.14**	**0.07**	**0.08**
	CD (P=0.05)	**0.27**	**0.17**	**0.24**	**0.43**	**0.21**	**0.24**

Note* Data in parenthesis are pre transformed original values, which were transformed to $\sqrt{(x + 0.5)}$ and analysed statistically

4.4.3 Dry weight of weeds

The data on dry matter of weeds in different weed management practices recorded at 20, 40, 60 DAS and at harvest are presented in Table 4.14, 4.15, 4.16 and 4.17.

As the count of *Echinochloa colona, Chenopodium album, Alternanthera sessilis,* and collectively other weeds was near to the zero in the black polythene mulch (T_2) hence the dry weight of these weeds was also zero at 20 and 40 DAS. However, among the other weed management treatments, the lowest dry weight of *Echinochloa colona, Chenopodium album, Alternanthera sessilis,* and other weeds was observed in stale seed bed + 25% higher plant density + mulching with paddy straw + hand weeding at 30 DAS (T_4) which was followed by mulching with paddy straw mulch 5 t ha^{-1} (T_3) and hand weeding twice at 20 and 40 DAS (T_1). The higher dry matter of all these weeds was observed at 20 DAS in hand hoe 20 and 40 DAS (T_5) and weed mulching 20 DAS (in – situ mulching of weeds in between rows) + one hand weeding at 40 DAS (T_8) respectively. With respect to total dry weight of weeds at 20 DAS, the lowest weed dry weight was also observed in black polythene mulch (20 micron thickness) followed by stale seed bed + 25% higher plant density + mulching with paddy straw + hand weeding at 30 DAS (1.42 g m^{-2}) which was significantly superior over rest of the weed management practices in terms of reducing the dry weight of weeds.

At 40 DAS, the lowest dry weight of *Medicago denticulata* observed under black polythene mulch (20 micron thickness) while, dry weight of weeds like *Echinochloa colona, Chenopodium album Alternanthera sessilis,* other weeds and total dry weight of weeds were observed in stale seed bed + 25% higher plant density + mulching with paddy straw + hand weeding at 30 DAS (T_4). However, other treatments *viz.* hand weeding twice at 20 and 40 DAS (T_1), paddy straw mulch 5 t ha^{-1} (T_3), live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (T_7) were next in order and reduced weed dry weight over rest of the other treatments. The highest dry weight of all the observed weeds along

with total dry weight of weeds at 40 DAS was recorded under hand hoe 20 and 40 DAS (T_5) and live mulching with green gram (incorporation 30 DAS) (T_6).

Even at 60 DAS, among different weed management practices, the black polythene mulch (T_2) treatment was again found superior over all the treatment. as there were lowest dry weight of weeds in this treatment. The lowest dry weight of *Echinochloa colona*, *Alternanthera sessilis* and other weeds recorded in stale seed bed + 25% higher plant density + mulching with paddy straw + hand weeding at 30 DAS and it was significantly superior over rest of the treatments in reducing the dry weight of weeds. In case of *Chenopodium album* and *Alternanthera sessilis*, hand weeding twice at 20 and 40 DAS and paddy straw mulch 5 t ha^{-1} were comparable with stale seed bed + 25% higher plant density + mulching with paddy straw + hand weeding at 30 DAS. On the contrary, the total highest weed dry weight (21.8 g m^{-2}) was observed in live mulching with green gram (incorporation 30 DAS).

As regards to total weed dry weight at harvest, the lowest value was observed in black polythene mulch (20 micron thickness) and stale seed bed + 25% higher plant density + mulching with paddy straw + hand weeding at 30 DAS followed by paddy straw mulch 5 t ha^{-1} and hand weeding at 20 and 40 DAS (Table 4.17).

Table 4.14: Weed dry weight (g m^{-2}) at 20 DAS of sweet corn as influenced by different organic weed management practices

	Treatment	Weed Dry weight (g m^{-2})					
		Medicago Denticulata	***Echinochloa colona***	***Chenopodium album***	***Alternanthera sessilis***	**Others**	**Total**
T_1	Hand weeding twice at 20 and 40 DAS	1.62 (2.13)	1.57 (1.97)	089 (0.30)	1.29 (1.17)	1.03 (0.57)	2.58 (6.13)
T_2	Black polythene mulch (20 micron thickness)	0.72 (0.02)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.72 (0.02)
T_3	Paddy straw mulch 5 tonne ha^{-1}	0.75 (0.06)	1.09 (0.70)	0.75 (0.06)	1.00 (0.50)	0.98 (0.23)	0.86 (1.55)
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	0.73 (0.04)	1.03 (0.57)	0.74 (0.04)	1.04 (0.60)	0.86 (0.13)	1.12 (1.38)
T_5	Hand hoe twice 20 and 40 DAS	1.63 (2.17)	1.68 (2.33)	0.96 (0.43)	1.22 (1.00)	1.37 (0.77)	1.03 (6.70)
T_6	Live mulching with green gram (incorporation 30 DAS)	1.52 (1.80)	1.46 (1.63)	1.09 (0.70)	1.14 (0.80)	1.25 (0.57)	0.95 (5.50)
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	1.48 (1.70)	1.35 (1.33)	1.02 (0.53)	1.13 (0.77)	1.13 (0.40)	1.09 (4.73)
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	1.63 (2.17)	1.64 (2.20)	1.12 (0.77)	1.12 (0.77)	1.34 (0.70)	2.66 (6.60)
	SEm ±	**0.02**	**0.05**	**0.04**	**0.05**	**0.04**	**0.03**
	CD (P=0.05)	**0.05**	**0.14**	**0.13**	**0.16**	**0.12**	**0.10**

Note* Data in parenthesis are pre transformed original values, which were transformed to $\sqrt{(x + 0.5)}$ and analysed statistically

Table 4.15: Weed dry weight (g m^{-2}) at 40 DAS of sweet corn as influenced by different organic weed management practices

	Treatment	Weed Dry weight (g m^{-2})					
		Medicago Denticulata	***Echinochloa colona***	***Chenopodium album***	***Alternanthera sessilis***	**Others**	**Total**
T_1	Hand weeding twice at 20 and 40 DAS	1.59 (2.03)	1.25 (1.07)	1.14 (0.80)	1.33 (0.77)	1.10 (0.70)	2.42 (5.37)
T_2	Black polythene mulch (20 micron thickness)	1.20 (0.93)	1.17 (0.87)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	1.52 (1.80)
T_3	Paddy straw mulch 5 tonne/ha	1.78 (2.67)	1.32 (1.23)	1.28 (1.13)	1.14 (0.80)	1.09 (0.70)	2.65 (6.53)
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	1.58 (2.00)	1.02 (0.53)	0.98 (0.47)	0.71 (0.00)	0.71 (0.00)	1.87 (3.00)
T_5	Hand hoe twice 20 and 40 DAS	2.17 (4.20)	1.50 (1.77)	1.80 (2.73)	1.06 (0.63)	1.43 (1.53)	3.37 (10.87)
T_6	Live mulching with green gram (incorporation 30 DAS)	2.11 (3.97)	1.67 (2.30)	1.69 (2.37)	1.44 1.57	1.20 (0.93)	3.41 (11.13)
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	1.66 (2.27)	1.30 (1.20)	1.43 (1.53)	1.40 (1.47)	1.11 (0.73)	2.77 (7.20)
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	2.07 (3.77)	1.41 (1.50)	1.77 (2.63)	0.89 (0.33)	1.30 (1.20)	3.15 (9.43)
	SEm ±	**0.03**	**0.02**	**0.03**	**0.10**	**0.03**	**0.04**
	CD (P=0.05)	**0.08**	**0.05**	**0.08**	**0.31**	**0.08**	**0.11**

Note* Data in parenthesis are pre transformed original values, which were transformed to $\sqrt{(x + 0.5)}$ and analysed statistically

Table 4.16: Weed dry weight (g m^{-2}) at 60 DAS of sweet corn as influenced by different organic weed management practices

	Treatment	Weed Dry weight (g m^{-2})					
		Medicago Denticulata	***Echinochloa colona***	***Chenopodium album***	***Alternanthera sessilis***	**Others**	**Total**
T_1	Hand weeding twice at 20 and 40 DAS	1.64 (2.20)	1.58 (2.00)	1.67 (2.30)	1.32 (1.23)	1.59 (2.03)	3.20 (9.77)
T_2	Black polythene mulch (20 micron thickness)	1.52 (1.80)	1.51 (1.80)	1.24 (1.03)	0.71 (0.00)	0.71 (0.00)	2.27 (4.63)
T_3	Paddy straw mulch 5 tonne ha^{-1}	1.66 (2.27)	1.68 (2.33)	1.34 (1.30)	1.58 (2.00)	1.65 (2.23)	3.26 (10.13)
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	1.65 (2.23)	1.32 (1.23)	1.06 (0.63)	1.05 (0.60)	1.05 (0.60)	2.41 (5.30)
T_5	Hand hoe twice 20 and 40 DAS	1.92 (3.20)	2.03 (3.63)	1.80 (2.73)	1.92 (3.20)	1.66 (2.27)	3.34 15.03
T_6	Live mulching with green gram (incorporation 30 DAS)	2.33 (4.93)	2.46 (5.57)	2.09 (3.87)	2.16 (4.17)	1.94 (3.27)	4.72 (21.80)
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	2.12 (4.00)	2.15 (4.13)	1.68 (2.33)	2.00 (3.50)	1.68 (2.33)	4.10 (16.30)
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	1.90 (3.10)	1.97 (3.37)	1.74 (2.53)	1.87 (3.00)	1.63 (2.17)	3.83 (14.17)
	SEm ±	**0.04**	**0.03**	**0.03**	**0.02**	**0.02**	**0.04**
	CD (P=0.05)	**0.12**	**0.10**	**0.10**	**0.05**	**0.05**	**0.12**

Note* Data in parenthesis are pre transformed original values, which were transformed to $\sqrt{(x + 0.5)}$ and analysed statistically

Table 4.17: Weed dry weight (g m^{-2}) at harvest of sweet corn as influenced by different organic weed management practices

	Treatment	Weed Dry weight (g m^{-2})					
		Medicago denticulata	***Echinochloa colona***	***Chenopodium album***	***Alternanthera sessilis***	**Others**	**Total**
T_1	Hand weeding twice at 20 and 40 DAS	2.12 (4.00)	1.92 (3.20)	2.02 (3.60)	1.64 (2.20)	1.67 (2.30)	3.97 (15.30)
T_2	Black polythene mulch (20 micron thickness)	1.67 (2.30)	1.58 (2.00)	1.50 (1.77)	0.71 (0.00)	0.71 (0.00)	2.56 (6.07)
T_3	Paddy straw mulch 5 tonne ha^{-1}	1.96 (3.33)	1.76 (2.63)	1.92 (3.20)	1.82 (2.83)	1.38 (1.40)	3.72 (13.40)
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	1.74 (2.53)	2.17 (4.23)	1.80 (2.73)	1.55 (1.90)	1.15 (0.83)	3.57 (12.23)
T_5	Hand hoe twice 20 and 40 DAS	2.39 (5.20)	2.12 (4.00)	2.16 (4.17)	1.84 (2.93)	1.70 (2.40)	4.38 (18.70)
T_6	Live mulching with green gram (incorporation 30 DAS)	2.52 (5.83)	2.48 (5.67)	2.41 (5.30)	2.13 4.17	1.70 (3.27)	4.97 (24.23)
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	2.44 (5.47)	2.16 (4.17)	2.19 (4.30)	2.11 (4.00)	1.72 (2.47)	4.57 (20.40)
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	2.24 (4.50)	2.07 (3.80)	2.07 (3.77)	2.10 (3.90)	1.68 (2.33)	4.34 (18.30)
	SEm ±	**0.07**	**0.02**	**0.02**	**0.14**	**0.02**	**0.07**
	CD (P=0.05)	**0.20**	**0.05**	**0.07**	**0.42**	**0.05**	**0.23**

Note* Data in parenthesis are pre transformed original values, which were transformed to $\sqrt{(x + 0.5)}$ and analysed statistically

4.4.4 Weed control efficiency

Weed control efficiency indicate the percent reduction in weed population or dry weight of weeds under treated plot in comparison to untreated plot or weedy plot. The weed control efficiency of different treatment was worked out over (T6) live mulching with green gram (incorporation 30 DAS) because in this treatment no weeding operation was done and the maximum number of weeds was counted in this treatment.

The weed control efficiency was computed at 60 DAS and at harvest as influenced by different weed management practices (Table 4.18).

Table 4.18: Weed control efficiency (%) of different organic weed management practices.

	Treatment	Weed control efficiency (%)	
		60 DAS	At harvest
T_1	Hand weeding twice at 20 and 40 DAS	60.76	47.0
T_2	Black polythene mulch (20 micron thickness)	84.55	72.90
T_3	Paddy straw mulch 5 tonne ha^{-1}	70.04	49.37
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	70.68	51.90
T_5	Hand hoe twice 20 and 40 DAS	30.24	30.79
T_6	Live mulching with green gram (incorporation 30 DAS)	-	-
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	20.68	16.15
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	52.41	33.56

Among the different weed management practices, the highest weed control efficiency (84.55 %) was recorded at 60 DAS under black polythene mulch 20 micron thickness (T_2) over all the other weed management practices followed by stale seed bed + 25% higher plant density + mulching with paddy straw + hand

weeding at 30 DAS (70.68 %) (T_4), straw mulch 5 t ha^{-1} (70.04 %) (T_3) and hand weeding 20 and 40 DAS (60.76%) (T_1). was found better in controlling the weeds population. The lowest WCE % was observed under live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (20.68 %) (T_7) and hand hoe twice 20 and 40 DAS (30.24 %).

At harvest among the various weed management practices black polythene mulch (20 micron thickness (72.90 %) (T_2) was found superior over all the treatments. stale seed bed + 25% higher plant density + mulching with paddy straw + hand weeding at 30 DAS (51.90 %) (T_4) was found more efficient WCE % followed by paddy straw mulch 5 t ha^{-1} (T_3) (49.37 %) and lowest weed control efficiency found under live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (16.15 %) (T_7) and hand hoe twice 20 and 40 DAS (30.79 %).

4.5 Economics

The data presented in Table 4.19 revealed that weed management practices significantly affect the economics of the crop. Cost of cultivation was the highest in black polythene mulch. Variation in cost of cultivation of sweet corn amongst different weed management practices was mainly due to cost of black polythene mulch, stale seed bed, paddy straw mulch 5 t ha^{-1} and labour charges

4.5.1 Cost of cultivation

Among all the different weed management practices, the highest cost of cultivation was (Rs.65531 ha^{-1}) incurred in black polythene mulch (20 micron thickness) followed by stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (Rs. 63981 ha^{-1}), hand weeding twice at 20 and 40 DAS (Rs. 60906 ha^{-1}), paddy straw mulch 5 tone ha^{-1} (Rs. 60406 ha^{-1}), weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS (Rs. 59531ha^{-1}). This might be due to higher cost of black polythene mulch and labour intensive hand weeding. The lowest cost of cultivation (Rs. 56366 ha^{-1}) was observed from live mulching with green gram (incorporation

30 DAS) and live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (Rs. 57741 ha^{-1}) (Table 4.19)

4.5.2 Gross return

The maximum gross income (Rs. 254833 ha^{-1}) was obtained in black polythene mulch (20 micron thickness) (T_2) owing to the highest cob yield than the other weed management practices. Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (Rs. 234787 ha^{-1}) was next in order which was followed by paddy straw mulch 5 t ha^{-1} (T_3) (Rs. 223487 ha^{-1}) and hand weeding twice at 20 and 40 DAS (T_1) (Rs. 214413 ha^{-1}). While the lowest gross income (Rs.137580 ha^{-1}) was obtained in live mulching with green gram (incorporation 30 DAS) (T_6) and live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (Rs. 178820 ha^{-1}). Due to effective weed control in black polythene mulch, there was lowest weed as a result vigorous crop growth was attained which resulted into higher yield converted into gross income.

4.5.3 Net return

Among all the weed management practices, highest net income was obtained in black polythene mulch treatment (Rs. 189302 ha^{-1}) followed by stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (Rs. 170805 ha^{-1}) and paddy straw mulch 5 t ha^{-1} (T_3) (Rs. 163080 ha^{-1}). While lowest net income was achieved in live mulching with green gram (incorporation 30 DAS) (Rs 81213 ha^{-1}) (T_6).

4.5.4 Benefit: Cost ratio

The highest B: C ratio (3.89) was observed in black polythene mulch (T_2) followed by paddy straw mulch 5 t ha^{-1} (T_3) (3.70) and stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) (3.67) and hand weeding twice at 20 and 40 DAS (T_1) (3.52). While the lowest B: C ratio (2.44) was obtained in live mulching with green gram (incorporation 30 DAS) (T_6).

Table 4.19: Economics of sweet corn as influenced by different organic treatments of weed management practice.

	Treatments	Total Cost (Rs ha^{-1})	Gross Return (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
T_1	Hand weeding twice at 20 and 40 DAS	60906	214413	153507	3.52
T_2	Black polythene mulch (20 micron thickness)	65531	254833	189302	3.89
T_3	Paddy Straw mulch 5 tonne ha^{-1}	60406	223487	163080	3.70
T_4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	63981	234787	170805	3.67
T_5	Hand hoe twice 20 and 40 DAS	58156	183073	124917	3.15
T_6	Live mulching with green gram (incorporation 30 DAS)	56366	137580	81213	2.44
T_7	Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	57741	178820	121078	3.10
T_8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	59531	194413	134882	3.27

Price of green cob : Rs. 30 kg^{-1}, Price of straw Rs. 200 q^{-1}

CHAPTER–V
SUMMARY AND CONCLUSION

Field trial on **"Effect of different organic weed management practices on growth and yield of sweet corn'' (*Zea mays* L. *saccharata*)"** was accomplished in rabi season of 2020-21 at Research cum Instructional Farm, IGKV, Raipur, (C.G.)

The experiment was laid out in a randomized block design with eight treatments having three replications. The treatments included T_1- Hand weeding twice at 20 and 40 DAS, T_2- Black polythene mulch (20 micron thickness), T_3- Straw mulch 5 tonne ha^{-1}, T_4- Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS, T_5- Hand hoe twice 20 and 40 DAS, T_6- Live mulching with of green gram (incorporation 30 DAS), T_7- Live mulching with of green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS, T_8- Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS. The gross plot size was (8 m × 3 m) and net plot size was (7.20 m x 2.40 m).

The soil of the experimental field was clayey in texture with low nitrogen, medium phosphorus and high potassium content. The pH value of soil was neutral in reaction. Manual sowing of sweet corn (sugar 75) was done in lines maintaining distance of 40 × 30 cm row to row and plant to plant except in the treatment of stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS, where the distance was maintained 32 × 30 cm. The recommended dose of NPK (80: 50: 30 kg ha^{-1}) was applied through organic sources i.e. 50 % N from FYM (Farm yard manure), 25 % N from vermicompost and 25 % N from poultry manure.

There was no incidence of any pests and disease on experimental crop. All the recommended cultural operations were followed according to the requirement of the treatments. Black polythene mulch was applied before one day of sowing, The Hand weeding was done twice at 20 and 40 DAS, Hand hoe twice at 20 and 40 DAS, preparation of stale seed bed 25 days before sowing, paddy straw mulching 5 t ha^{-1} at 10 DAS, live mulching with green gram (incorporation 30 DAS) and in-situ weed

mulching were managed as per schedule. The observations recorded during the course of investigation summarized below.

- The data on initial plant population at 20 DAS was almost similar in all treatments except in stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS, where dense spacing increased the plant population. The observation taken on plant height, number of leaves plant^{-1}, leaf area, plant dry matter accumulation and CGR, RGR were significantly influenced by different weed management practices and registered in the black polythene mulch treatment the higher value of growth parameters.

- Yield attributing traits like no. of cobs plant^{-1}, no. of grains cob^{-1}, green cob yield, stover yield, weed index were found significantly superior in black polythene mulch (20 micron thickness) and lowest in live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (T_7). Growth parameter of sweet corn as well as crop growth rate were the maximum in black polythene mulch 20 micron thickness However, other treatments like stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4), paddy straw mulch 5 t ha^{-1} (T_3) and hand weeding twice 20 and 40 DAS were comparable to black polythene mulch. While, live mulching with green gram (incorporation 30 DAS) resulted in the lowest values of these parameters.

- The observations recorded on weeds revealed that among all the weed management practices, the lowest weed density and weed dry weight was recorded under black polythene mulch (T_2) over rest of the treatments and it was followed by stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4), straw mulch 5 t ha^{-1} (T_3) and hand weeding at 20 and 40 DAS (T_1). The highest weed density and weed dry weight was recorded under live mulching with green gram (incorporation 30 DAS) (T_6) and live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (T_7). The treatment black polythene mulch (T_2) was found overall superior for controlling the weeds.

- Among all the different weed management practices, the maximum cost of cultivation was incurred in black polythene mulch treatment (Rs.65531 ha^{-1}), followed by stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (Rs. 63981 ha^{-1}), hand weeding twice at 20 and 40 DAS (Rs. 60906 ha^{-1}) and paddy straw mulch 5 tone ha^{-1} (Rs. 60406 ha^{-1}), weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS (Rs. 59531ha^{-1}) in descending order. The Least cost of cultivation was involved in live mulching with green gram (incorporation 30 DAS) (Rs. 56366 ha^{-1}) (T_6) followed by live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (Rs. 57741 ha^{-1}) (T_7). The maximum gross income was obtained in black polythene mulch 20 micron thickness (T_2) (Rs. 254833 ha^{-1}). Owing to the highest cob yield than the other weed management practices, including stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (Rs. 234787 ha^{-1}) was next in order which was followed by paddy straw mulch 5 t ha^{-1} (T_3) (Rs. 223487 ha^{-1}) and hand weeding twice at 20 and 40 DAS (T_1) (Rs. 214413 ha^{-1}). While the lowest gross income was generated in live mulching with green gram (incorporation 30 DAS) (Rs.137580 ha^{-1}) (T_6). Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS (T_7) gave Rs. 178820 ha^{-1}.

- Highest net income was achieved in black polythene mulch treatment (Rs. 189302 ha^{-1}) followed by stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (Rs. 170805 ha^{-1}) and paddy straw mulch 5 t ha^{-1} (T_3) (Rs. 163080 ha^{-1}). While lowest net income was obtained in live mulching with green gram (incorporation 30 DAS) (Rs 81213 ha^{-1}) (T_6). However, the benefit cost ratio was highest in black polythene mulch (T_2) (3.89) and paddy straw mulch 5 t ha^{-1} (T_3) (3.70) followed by stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (T_4) (3.67). While the lowest B: C ratio (2.44) was observed in (T6) i.e., live mulching with green gram (incorporation 30 DAS).

5.2 Conclusions

On the basis of the experimental result, following conclusion can be drawn:

- Black plastic mulch was found to be the best for better growth, yield attributing characters and green cob yield (7.42 t ha^{-1}) of sweet corn which was found statistically similar with stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (6.80 t ha^{-1}).
- As regards to the various weed observation, the minimum weed density and dry weight was marked in black polythene mulch and stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS. The maximum Weed control efficiency and minimum weed index was also observed in black polythene mulch was found superior this treatment followed by mulching with stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS. The higher yields was direct clearly related by percent reduction of weed density, biomass and weed control efficiency (WCE %).
- The highest gross return (Rs. 254833 ha^{-1}) and net return (Rs. 189302 ha^{-1}) was achieved in black polythene mulch and stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS (Rs. 234787 ha^{-1}) and (Rs. 170805 ha^{-1}), but B: C ratio (3.89) and (3.70 was found highest in black polythene mulch and paddy straw mulch 5 t ha^{-1}.

5.3 SUGGESTIONS FOR FUTURE RESEARCH WORK

In the context of experience gained in research and worked out of the thesis, the following points were found to be of main consideration in future studies.

- ✓ Research can also be done to find out the effect of these organic weed management practices with the same treatment set in normal maize and other widely spaced crops like sunflower and cotton etc.
- ✓ The same experiment can be repeated for one or more year to get confirmation of results of organic weed management practices in different soil types.

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Appendix - A: Weekly meteorological observations during crop growth period (From 24 December 2020 to 22 April, 2021

SMW	DATE	MAXT (°C)	MINT (°C)	RF (mm)	RH I (%)	RH II (%)	VP I (mm)	VP II (mm)	WS(kmph)	EP(mm)	SS (hr)
52	24 Dec. – 31 Dec. 2020	**28.41**	**10.27**	**0**	**87**	**27.5**	**8.77**	**7.78**	**1.8**	**3.07**	**4.81**
1	01 Jan – 07/ Jan 2021	29.67	13.8	0	84.85	32.14	10.84	9.38	2.22	2.87	3.21
2	8 Jan – 14 Jan 2021	31.15	16.31	0	78.42	30	11.57	9.67	2.38	3.22	3.88
3	15 Jan -21 Jan 2021	30.00	11.74	0	83.14	24	9.3	7.6	2.57	3.42	6.11
4	22 Jan – 28 Jan 2021	31.00	14.17	0	80	35.57	10.4	11.51	2.6	3.48	3.31
5	29 Jan – 04 Feb 2021	28.18	10.34	4.6	81.14	22.71	8.41	6.44	2.82	3.44	6.84
6	5 Feb – 11 Feb 2021	30.05	10.62	0	77.57	20.42	7.97	6.08	2.52	3.92	9.45
7	12 Feb – 18 Feb 2021	31.42	14.9	1.0	79.57	40.57	11.28	12.05	2.85	3.62	3.57
8	19 Feb – 25 Feb 2021	30.91	14.51	1.4	81.42	29.85	11.18	9.72	2.75	3.88	7.37
9	26 Feb – 04 March 2021	35.80	15.67	0	68.57	16.28	10.11	6.82	3.07	6.04	9.52
10	5 March – 11 March	36.28	17.25	0	64	21.14	10.44	9.12	3.45	6.14	8.25
11	12 March – 18 March	34.68	19.44	6.2	75.71	26.57	13.78	10.47	3.3	5.15	5.9
12	19 March – 25 March	35.12	20.07	1.4	65.14	27.85	13.52	10.74	4.24	5.07	4.95
13	26 March – 1 April	39.68	20.57	0	51.14	14	9.97	7.4	4.62	8.05	8.27
14	02 April – 08 April	40.35	21.38	0	56.57	18.14	12.27	10.14	3.85	8.02	7.42
15	09 April – 15 Aprail	38.51	23.8	0	53.14	22.42	13.75	10.42	6.15	8.144	5.74
16	16 April – 22 April	38.81	23.15	1.0	55.28	22.57	14.12	11.32	4.95	6.95	6.71

Appendix – B: Cost of cultivation

S.no.	Fixed cost	Inputs (ha^{-1})	Rate/Unit (Rs.)	Amount in (Rs.)
1.	Preparation of land			
	a. Ploughing 1 times	2 hrs	800 Rs/hr	1600
	b. Cultivator 2 times	2 hrs	800 Rs/hr	1600
	c. Rotavator 1 time	1 and $^1/_2$ hrs	800 Rs/hr	1200
2.	Cost of seed material			
	a. Seed	8kg	2800 Rs/kg	22400
	b. Sowing	15 labour	275Rs/labour	4125
3.	Manure			
	a. FYM	7.54 tone/ha (50% N)	750 Rs/tractor (4tone/tractor)	1406
	b. Vermicompost 1200 Rs/quintal	9.4 q/ha (25% N)	1000 Rs/quintal (10 Rs/kg)	9400
	c. Poultry mannure	8.5 q/ha (25% N)	250Rs/quintal (2.5 Rs/kg)	2125
	d. Spreading of manure	10 labour	275 Rs/labour	2750
4.	Irrigation 1200/ha	4 Irrigation	300 Rs/ Irrigation	1200
5.	Harvesting			
	a. Manual picking of green cob	14 labour for two picking	275 Rs/labour	3850
6.	Miscellaneous			1000
	Total			**52656**

Appendix-C: Variable cost of cultivation of sweet corn as influenced by different organic weed management practices

	Treatments	Treatment Cost (Rs ha^{-1})	Fixed Cost (Rs ha^{-1})	Total Cost (Rs ha^{-1})	Gross Return (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
T1	Hand weeding twice at 20 and 40 DAS	8250	52656	60906	214413	153507	3.52
T2	Black polythene mulch (20 micron thickness)	12875	52656	65531	254833	189302	3.89
T3	Straw mulch 5 tonne ha^{-1}	7750	52656	60406	223487	163080	3.70
T4	Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding at 30 DAS	11325	52656	63981	234787	170805	3.67
T5	Hand hoe twice 20 and 40 DAS	5500	52656	58156	183073	124917	3.15
T6	Live mulching with of green gram (incorporation 30 DAS)	3710	52656	56366	137580	81213	2.44
T7	Live mulching with of green gram (incorporation 30 DAS) + one intra row hand weeding at 30 DAS	5085	52656	57741	178820	121078	3.10
T8	Weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS	6875	52656	59531	194413	134882	3.27

Price of green cob : Rs. 30 kg^{-1}, Price of straw Rs. 200 q^{-1}

RESUME

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