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Effect of smother crops and green leaf manures on weed dynamics and yield of organic sweet corn

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Abstract
In the present-day context, organic sweet corn assuming greater importance due to its chemical free nature and has a big market potential. Weed menace is one of the major challenges under organic production system. Therefore, a field experiment was conducted at All India Network Programme on Organic Farming (NPOF) unit at University of Agricultural Sciences, Dharwad on *Vertisols* with medium soil fertility during *kharif* 2020 and 2021 to find out suitable intercropping followed by in situ mulching and green leaf manure (GLM) for weed management in sweet corn under organic production system. The experiment was laid out in Randomized Complete Block Design with three replications. The treatment comprises of four intercrops *viz*., cowpea, green gram, sun hemp and sesbania with 1:1 proportion and were mulched at 35 DAS and three GLM *viz*., *Gliricidia sepium*, *Pongamia pinnata* and *Cassia sericea* @ 5 t ha^{-1} were mulched at 18 DAS and Inter cultivation at 20 and 40 DAS followed by one hand weeding at 20 DAS, Weedy check, Weed free check. The results of the experiment indicated that intercropping with cowpea (1:1) and mulching at 35 DAS recorded significantly higher fresh cob yield (169 q ha^{-1}) and fresh fodder yield (343 q ha^{-1}) as compared to other treatments. At 30 DAS, significantly lower total number of weeds (2.65 m^{-2}) and total weed dry matter (3.06 g m^{-2}) were observed under intercropping with cowpea (1:1) and mulched at 35 DAS with higher weed control efficiency (91.72%). However, these results were on par with intercropping with green gram (1:1) and mulched at 35 DAS.

Keywords: Mulching, organic weed management, sweet corn, weed control efficiency

Introduction
Maize (*Zea mays* L.) is one of the most important cereal crops grown all over the world as food and also as cattle and poultry feed. Maize belongs to Poaceae family and has an important position in crop husbandry because of its higher yield potential and short duration. Due to its high yielding nature among the cereal crops, it is popularly known as "Queen of cereals". It can be grown under various environmental conditions. Maize grain contains about 72% starch, 10% protein, 4.8% oil, 9.5% fiber, 3% sugar, and 1.7% ash.

The maize is classified into seven groups based on the characters of grain. *viz.*, dent corn, flint corn, sweet corn, flour or soft corn, pop corn, baby corn and waxy corn. Among which, sweet corn (*Zea mays* L. var. *saccharata* Sturt) is mainly grown in USA and Canada. It is also known as sugar corn, it is a hybridized variety of maize (*Zea mays* L.) specifically bred to increase the sugar content. Grains possess a considerable amount of sugar. It differs from dent type only by one recessive gene which prevents the conversion of sugar into starch. After maturity, grains become wrinkled. The cobs are picked up green for canning and table purpose. Sweet corn is the same botanical species as a common corn; the main difference is that the endosperm in the grains of fresh sweet corn has greater polysaccharide content. Sweet corn (*Zea mays* L. var. *saccharata* Sturt) was introduced to India from USA. The fruit of the sweet corn plant is the corn grain. It has a sugary rather than a starchy endosperm and a creamy texture. The low starch level makes the grain wrinkled rather than plumpy.

Sweet corn is gaining popularity in urban areas of India because of its higher sugar (11-20%), low starch content and delicious nature. People living in urban areas prefer roasted sweet corn cobs as they are very tasty and nutritious. Roasted green cobs provide starch, fat, protein, sugar, minerals and vitamins in palatable and digestible form at relatively low cost. Sweet corn is gaining importance in the star hotels and urban areas for preparation of special soups, sweets, jams, cream, pastes and other delicious eatables. It is also grown as a vegetable to be eaten fresh and in some parts of the world it is used to produce syrup. Besides, its fodder is highly succulent, palatable and digestible. In India, sweet corn is cultivated on very small area by some farmers and private sectors to meet the demands of many industries.

The net income from sweet corn is higher as compared to grain maize.

Generally Maize is not responding to organic farming as its nutrients requirement is quite high. In the initial years of conversion 30-40% yield reduction was common in Maize, but in sweet corn, yield reduction can be well compensated by higher price and urban people prefer organically produced sweet corn.

Among different biotic factors which have a significant influence on the performance of sweet corn, weeds are the most important one. Weeds are unwanted plants playing a very significant role in different agro-eco-system and many of them cause direct and indirect losses. Weeds cause huge reduction in crop yield but also increase cost of cultivation and reduce input use. Maize plant is vigorous and tall in nature and it is very sensitive to weed competition at early stages of growth. Yield losses in maize crop due to weeds are estimated up to 35 per cent. Understanding the ecological relationship in crop – weed competition, it is significantly important to develop an effective crop management technology and to prevent the huge loss due to weeds.

Weeding has traditionally been a labour-intensive operation in crop production. Different weed control practices like chemical, cultural, physical and biological are used to control the weeds. Herbicidal weed management has become a key component in almost all weed management strategies. At the same time, the continuous use of the same group of herbicides over a period of time on a same piece of land leads to ecological imbalance in terms of weed shift, herbicide resistance in weeds and environmental pollutions. **(**Gnanavel and Natarajan, 2014) [4].

Herbicide application may also sometime affect beneficial microorganisms and indirectly helps in disease causing organisms to become a problem (Kalia and Gupta, 2004) [7]. Continuous use of herbicides for longer period may sometimes leads to serious ecological problems. Organic way of cultivation is suitable to overcome these problems and to reduce the residual effect of agrochemicals. Some of the organic methods of weed management are mechanical weeding, growing of cover crop, crop rotation with legume and non- legume crops, modifying the sowing and planting techniques, changing sowing and planting time, mulching with organic residues, green manuring and the adoption of reduced or zero tillage, soil solarization, hand weeding, spray of phyto extracts and intercropping makes an inappropriate environment for weed seed germination and their growth which results in better yield.

Material and Methods

a field experiment was conducted at All India Network Programme on Organic Farming (NPOF) unit at University of Agricultural Sciences, Dharwad on *Vertisols* with medium soil fertility during *kharif* 2020 and 2021 to find out suitable intercropping followed by in situ mulching and green leaf manure (GLM) for weed management in sweet corn under organic production system. The experiment was laid out in Randomized Complete Block Design with three replications. The treatment comprises of four intercrops *viz*., cowpea, green gram, sun hemp and sesbania with 1:1 proportion and were mulched at 35 DAS and three GLM *viz*., *Gliricidia sepium*, *Pongamia pinnata* and *Cassia sericea* @ 5 t ha^{-1} were mulched at 18 DAS and Inter cultivation at 20 and 40 DAS followed by one hand weeding at 20 DAS, Weedy check, Weed free check. 9.2 tonnes of FYM and 4.40 tonnes of vermicompost applied to field to supply nutrient requirements. Weeds were counted on 30, 60 DAS and at harvest. grasses, sedges and broad-leaved weeds present within 1 m × 1 m random quadrant in each net plot were counted separately and expressed as number of weeds per square meter (No. m^{-2}). and were oven dried to a constant weight at 65 °C and dry weight of weeds in each treatment was recorded and expressed as grams per square meter (g m^{-2}). Data on fresh cob yield and fresh fodder were recorded at harvest.

Data on weed count and weed dry weight have shown high degree of variation. A relationship between the means and variance was observed. Therefore, the data on weed count and weed dry weight were subjected to square root of (x + 0.5) transformation to make analysis of variance more valid as suggested by Bartlett (1947) [10].

The experimental data obtained were subjected to statistical analysis by adopting Fisher's method of analysis of variance as outlined by Gomez and Gomez (1984) [5]. The level of significance used in 'F' test was at 5 per cent. The mean value subjected to Duncan's multiple range test (DMRT) using the corresponding mean sum of square and degree of freedom values.

Results and Discussion (pooled data)

Effect on weeds

At the experimental site, the grassy weeds, sedges and broad-leaved weeds were observed in combination with sweet corn. Among the grassy weeds *Brachiaria eruciformis*, *Cynodon dactylon* and *Dinebra retroflexa*. Among broad-leaved weeds *Alternanthera sessilis*, *Commelina benghalensis*, *Corchorous capsularis*, *Convolvulus arvensis*, *Ephorbia hirta*, *Phylanthus niruri and Portulaca oleracea*were noticed in the experimental site. Among the sedges, *Cyperus rotundus* was noticed. Broad-leaved weeds density dominated the weed flora among the various categories. All the weed management practices were effective in suppressing total weed density and dry matter as compared to weedy check (T_9). Minimum weed population and dry weight at 30 DAS were recorded under weed free check (T_{10}). Among the different weed management practices, inter-cultivation at 20 and 40 DAS and one hand weeding at 20 DAS (T_8) recorded significantly lower total weed density per m^2 and lover dry matter of weeds (2.29 and 4.58 g m^{-2} at 30, DAS, respectively) as compared to other weed management practices. This was on par with intercropping with cowpea (1:1) and mulching at 35 DAS (T_1). Among the different intercrops and green leaf manure, intercropping with cowpea (1:1) and mulching at 35 DAS (T_1) recorded significantly lower total weed density per m^2 and lover dry matter of weeds (2.65 and 4.95 4.58 g m^{-2} at 30 DAS, respectively) as compared to other intercrops and green leaf manure treatments.

Among different weed management practices, inter-cultivation at 20 and 40 DAS and one hand weeding at 20 DAS (T_8) recorded significantly higher weed control efficiency (93.57, 86.88 and 86.41%, at 30, 60 DAS and at harvest, respectively) as compared to other weed management practices. This was on par with intercropping with cowpea (1:1) and mulching at 35 DAS (T_1) at 30, 60 DAS and at harvest. Among the different intercrops and green leaf manure, intercropping with cowpea (1:1) and mulching at 35 DAS (T_1) recorded significantly higher weed control

efficiency (84.60% at 30 DAS) as compared to other intercrops and green leaf manure treatments. The intercropping with greengram (1:1) and mulching at 35 DAS (T_2) was on par with T_1 treatment at 30 DAS. It may be due to the effective control of weeds by mulching with cowpea crop control the weed germination and establishment through low temperature and light interception. This is in conformity with the findings of Choudhry *et al.*, (2014) [2].

Table 1: Total weed density, weed dry matter, weed control efficiency at 30 DAS and yield of sweet corn as influenced by different intercrops (mulching) and green leaf manures for weed management in sweet corn under organic production

Treatments	Total number of weeds (m^{-2})	Total dry matter of weeds (g m^{-2})	Weed control efficiency (%)	Fresh cob yield (q ha^{-1})	Fresh fodder yield (q ha^{-1})
T_1 - Intercropping with cowpea (1:1) and mulching at 35 DAS	2.65^{f} (6.50)	3.06^{de} (8.89)	91.72^{bc}	169^{bc}	343^{bc}
T_2 - Intercropping with greengram (1:1) and mulching at 35 DAS	3.09^{e} (9.03)	3.25^{d} (10.06)	90.64^{bc}	163^{cd}	336^{bc}
T_3 - Intercropping with sunhemp (1:1) and mulching at 35 DAS	4.06^{d} (15.98)	4.22^{c} (17.31)	83.87^{d}	155^{def}	319^{cd}
T_4 - Intercropping with sesbania (1:1) and mulching at 35 DAS	3.80^{d} (13.92)	4.00^{b} (15.54)	85.53^{cd}	157de	326^{c}
T_5 - Mulching with *Gliricidia sepium* @ 5 t ha^{-1}	5.26^{c} (27.20)	5.15^{b} (26.05)	75.75^{e}	145^{efg}	298de
T_6 - Mulching with *Pongamia pinnata* @ 5 t ha^{-1}	5.99^{b} (35.37)	5.59^{b} (30.78)	73.53^{e}	142^{g}	290^{e}
T_7 - Mulching with *Cassia sericea* @ 5 t ha^{-1}	5.51^{c} (29.81)	5.27^{b} (27.31)	74.58^{e}	144^{fg}	295de
T_8 - Inter-cultivation at 20 and 40 DAS and one hand weeding at 20 DAS.	2.29^{f} (4.75)	2.72^{e} (6.91)	93.57^{b}	181^{b}	359^{b}
T_9 - Weedy check	9.69^{a} (93.46)	10.40^{a} (107.66)	0.00^{f}	113^{h}	239^{f}
T_{10} - Weed free check	0.71^{g} (0.00)	0.71^{f} (0.00)	100.00^{a}	207^{a}	393^{a}
S.Em. ±	0.13	0.14	1.89	3.66	7.50

Note: * Transformed values ($\sqrt{x+0.5}$), figures in the parentheses indicate original values. DAS- Days after sowing
Means followed by the same letter (s) within a column are not significantly differed by DMRT (P = 0.05)

Effect on fresh cob yield and fodder yield

The weed free check (T_{10}) recorded significantly higher fresh cob yield (207 q ha^{-1}) followed by inter-cultivation at 20 and 40 DAS and one hand weeding at 20 DAS (T_8) (181 q ha^{-1}) compared to other treatments. Among all the different intercrops (mulching) and green leaf manure treatments, intercropping with cowpea (1:1) and mulching at 35 DAS (T_1) recorded significantly higher fresh cob yield (169 q ha^{-1}) and it was on par with T_8. Among the different green leaf manure treatments, higher fresh cob yield (145 q ha^{-1}) was noticed in mulching with *Gliricidia sepium* @ 5 t ha^{-1} (T_5). Whereas, significantly lower fresh cob yield (113 q ha^{-1}) was recorded in weedy check (T_9).

The weed free check (T_{10}) recorded significantly higher fresh fodder yield (393 q ha^{-1}) followed by inter-cultivation at 20 and 40 DAS and one hand weeding at 20 DAS (T_8) (359 q ha^{-1}). Among all the different intercrops (mulching) and green leaf manure treatments, intercropping with cowpea (1:1) and mulching at 35 DAS (T_1) recorded significantly higher fresh fodder yield (343 q ha^{-1}). However, it was on par with T_8 and T_2. Among the different green leaf manure treatments, higher fresh fodder yield (298 q ha^{-1}) was noticed in mulching with *Gliricidia sepium* @ 5 t ha^{-1} (T_5) followed by mulching with *Cassia sericea* @ 5 t ha^{-1}(T_7) (295 q ha^{-1}) and lower in mulching with *Pongamia pinnata* @ 5 t ha^{-1} (T_6) (290 q ha^{-1}). Whereas, significantly lower fresh fodder yield (239 q ha^{-1}) was recorded in weedy check (T_9). The improvement in fresh cob yield and fresh fodder yield could be attributed to better translocation of metabolites for cob development. It was due to reduced weed competition in these treatments. These results are in conformity with the findings of Sharma and Gautam (2006) [9].

Conclusion

Among different intercrops (mulching) and green leaf manures treatments, intercropping with cowpea (1:1) and mulching at 35 DAS recorded significantly lower weed density, lower weed dry matter, higher weed control efficiency, higher fresh cob yield and higher fresh fodder yield.

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