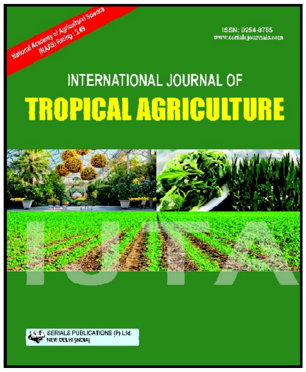

INTERNATIONAL JOURNAL OF TROPICAL AGRICULTURE

ISSN : 0254-8755

available at http: www.serialsjournals.com

Volume 36 • Number 4 • 2018

Effect of Mulches on *Capsicum Annum* Yield Attributes and Weed Control

Rakesh S. Chandran[1] and Kimberly A. Nelson[2]

[1] *West Virginia University, 3417 Ag. Sci. Bldg., Morgantown, WV 26506, USA.*
[2] *US EPA Gulf Ecology Division, 1 Sabine Island Drive, Gulf Breeze, Florida, 32561 USA.*

Abstract: Field experiments evaluated certain physical methods of weed control in organically-grown sweet pepper (*Capsicum annum* var. "Ace") under irrigated conditions. Hand cultivation, plastic mulch, and straw mulch were evaluated for weed control, growth attributes, and yield of sweet pepper at the West Virginia University Organic Research Farm, Morgantown, WV in 2001. Hand-cultivated plots and plastic mulch treatments provided at least 250% higher pepper yields than plots that received straw mulch or control treatment. In these treatments, approximately 20-fold yield increase was noted compared to untreated plots. Weed counts were lower in plots that received plastic mulch or hand cultivation. When the total weed count was correlated to pepper yield the correlation coefficient was -0.46, which indicated the significance of weed competition in sweet pepper yield reduction.

Keywords: Hand cultivation, organic weed control, non-chemical weed management, plastic mulch, straw mulch.

INTRODUCTION

Out of the 250,000 species of plants in the world roughly 200 species are recognized as weeds that cause problems in agriculture (Ross and Lembi, 1999). Conventionally, chemical methods are used for controlling weeds in commercial horticulture. However, there is an increasing demand for organically raised vegetables in North America. In the U.S., the United States Environmental Protection Agency (US-EPA) has restricted the use of certain herbicides and used in vegetable production because of ground water contamination and other potential adverse effects (Crnko *et al.,* 1992). Alternatives for fumigants such as methyl bromide are also sought.

Mechanical weed control methods typically include cultivation, hand-weeding, mowing, flooding, fire and heat, and mulches (Ross and Lembi, 1999). Mulching is considered to be an effective method of weed control in gardens and horticultural crops. A mulch can be described as any protective material placed on the soil surface, which controls the growth of weeds by excluding light using materials such as crop residue, straw, leaves, paper, plastic film, gravel, and dry soil. Mulching reduces plant stress and increases crop yield 15 to 800% by conserving moisture in the soil, reducing toxic chemical requirements, eliminating the growth of weeds, reducing rot and discoloration by keeping fruit off the ground, and helping crops to mature early and uniformly (Smith, 1968). However, perennial weeds with underground reproductive parts usually are usually not well controlled by mulches.

Ashworth and Harrison (1983) evaluated a variety of organic and synthetic mulch treatments used around vegetable crops and woody ornamental species. They found that organic mulches required application to a depth of at least 5 cm and that the most effective weed control was provided by black polyethylene because it remained intact throughout the summer. Similarly, field-grown tomatoes grown under black polyethylene had significantly higher total yield than those tomatoes without the mulch (Abdul-Baki, et al., 1992). Additionally, the use of black polyethylene mulch greatly increased fresh and dry weight yields of basil (*Ocimum basilicum* L.) and rosemary (*Rosmarinus officinalis* L.) (Ricotta and Masiunas, 1991; Davis 1994). Straw mulch at 16 tons per hectare has the capacity to reduce weed biomass by 30 to 83 percent and increase the yield of pointed gourd (*Trichosanthes dioica* L.) compared to unmulched plots (Ghorai and Bera, 1998).

Limited information is available to compare yield and growth attributes of sweet bell peppers (*Capsicum annum* L.) as affected by various weed control methods. The primary objectives of research were to determine the effects of mechanical weed control methods on yield and growth attributes, and weed control of sweet bell pepper.

MATERIALS AND METHODS

A field experiment was conducted in 2001 at the West Virginia University Organic Research Farm, Morgantown, WV, U.S.A. The soil type was a Dormont silt loam (fine-loamy, mixed, superactive, mesic Oxyaquic Hapludalfs), with pH 6.2 and 0.2-0.3 % organic matter on a 3% slope. Composted farmyard manure at 5 tons/Ha was broadcast and incorporated into the soil at a depth of 15 cm prior to laying out the plots. The experimental design was a randomized complete blocks (RCB) with four replications having 20 plots each of size 1.82 x 3.66 m. Treatments included hand cultivation, black plastic mulch, and straw mulch applied at three different heights (5, 10, and 20 cm). All plots were tilled to a depth of 15 cm prior to planting and rocks and organic debris were removed manually to ensure homogenous conditions prior to experimentation.

Wheat straw was spread to the predetermined depth using a standard ruler. Black polyethylene mulch (CWC, San Leandro, CA 94577) was applied as a single layer to cover the entire plot. The plastic mulch was secured to the soil using "U"-shaped landscape pins. Vegetable sweet peppers (*Capsicum sp.*), "Ace" were planted, 20 transplants, along four columns and five rows in each plot. The hand-cultivated plots were hoed or hand-weeded once a week to maintain weed-free plots during the duration of the experiment. All plots were drip-irrigated during periods of drought.

All plots were monitored for weed numbers by species on a weekly basis. Peppers that had undergone the color change (green to red) were harvested as maturity was indicated by changes in fruit pigmentation. Data recorded included fruit number, fresh weights, shoot dry weights, and weed counts by species. All data were subjected to analysis of variance (ANOVA) and means were separated using L.S.D (*P*=0.05).

RESULTS AND DISCUSSION

Pepper yield and growth

The leaves of the pepper plants in the straw mulch plots were chlorotic and the shoots were shorter than the non-straw mulched plots. Hand-cultivated plots and plastic mulch treatments provided at least 250% higher pepper yields than plots that received straw mulch or control treatment (*Table 1*). Pepper yields were similar between the mulched plots that received the same treatments regardless of the presence of a cover crop the previous year. Approximately 20-fold increase was noted in yield compared to untreated plots. A similar trend was also noticed with number of peppers harvested.

Weed Control

Weed counts of most species were considerably lower in plots that received plastic mulch or hand cultivation (*Table 2*). As expected, the weed counts correlated negatively with pepper yield although the *r* values were low which could be attributed to variability. When the total weed count was correlated to pepper yield the correlation coefficient was -0.46 which further indicated the significance of weed competition to reduce crop yields.

The results obtained from this study show that black polyethylene mulch provided for higher bell pepper yields than straw mulch and hand cultivation. Similarly, Davis (1994) found that black polyethylene provided for the highest basil yield and lowest weed pressure in field trials, as compared to wheat straw, hardwood bark, or mixed wood chips. Crutchfield, *et al.* (1985) found that weed population and weed yield decreased with increasing mulch level when wheat straw mulch was established at 0, 1.7, 3.4, 5.1, and 6.8 Mg/ha in stubble fields. Additionally, the water content in the surface layer of soil was found to increase with increasing mulch level. Tindall et al, (1991) found that root density increased with irrigation under plastic mulch. In a different field experiment under rain-fed conditions, hand cultivated plots and plots under plastic mulch resulted in pepper plants with similar masses of root tissue although plants that received plastic mulch produced a longer root system (Chandran, 2014). In this study, plastic mulch provided yields higher than that of hand-cultivated plots in un-irrigated peppers.

Though mulching aids in reducing manual irrigation by retaining water around the base of the plant, excessive moisture may increase the incidence of certain diseases in vegetable crops (Koike, *et al.,* 2003). Davis (1994) found that bacterial soft rot was highest on basil plants in the wheat straw mulch. However, straw mulch can improve adverse conditions of high temperature and low moisture more readily than black plastic mulch. Straw mulch contributes organic matter to the soil, reducing bulk density and mechanical impedance and increasing infiltration (Tindall *et al.,* 1991).

From the treatments we evaluated, it was clear that black plastic was the most cost-effective physical method to manage weeds in sweet pepper. This treatment also resulted in superior vegetable yields

Table 1

Yield and shoot weight of irrigated sweet pepper (*Capsicum annum L.* var. "Ace") as affected by physical weed control methods (2001)

Treatment	*Pepper yield*	*Pepper number*	*Shoot dry wt*
	— kg/plot —	*(per plot)*	*(g/plot)*
Hand Cultivation	16.68	175	692
Plastic Mulch	17.59	199	896
Straw Mulch (5 cm)	1.68	31	122
Straw Mulch (10 cm)	6.32	78	216
Straw Mulch (20 cm)	2.73	38	295
Control	0.05	10	12
L.S.D (*P*=0.05)	5.34	49	49

Table 2
Weed counts by species in plots 1.82 x 3.66 m and their respective correlation coefficients to sweet pepper (*Capsicum annum L.* var. "Ace") yield following various physical weed control treatments

Treatment	*Weed species**										
	CYRPO	*SOLPT*	*TRFRE*	*AMACH*	*POROL* *no./plot*	*CHEAL*	*MOLVE*	*ABUTH*	*ACCVI*	*ECHCG*	*PANDI*
Hand Cultivation	36.3	13.8	5.8	0.0	6.0	13.0	33.8	0.0	11.5	16.3	52.3
Plastic Mulch	0.0	4.6	2.5	0.0	0.0	0	9.4	0.0	0.1	0.0	0.0
Straw Mulch	37.8	21.0	8.0	1.3	1.3	5.0	0.0	0.0	4.5	12.5	2.0
Control	59.8	95.0	49.0	26.5	13.8	45.8	14.3	24.8	27.0	36.3	29.5
L.S.D (P=0.05)	71.4	48.0	27.9	10.9	8.9	23.5	29.7	24.5	21.5	29.9	38.3
r	-0.34	-0.19	-0.46	-0.31	-0.29	-0.35	+0.09	-0.14	-0.26	-0.21	-0.05

*CYPRO - *Cyperus esculentus* (Yellow nutsedge)
SOLPT - *Solanum ptycanthum* (Eastern black nightshade)
TRFRE - *Trifolium repens* (White clover)
AMACH – *Amaranthus hybridus* (Smooth pigweed)
POROL - *Portulaca oleracea* (Common purslane)
CHEAL – *Chenopodium album* (Common lambsquarters)
MOLVE – *Mollugo verticillata* (Carpetweed)
ABUTH - *Abutilon theophrasti* (Velvetleaf)
ACCVI – *Acalypha virginica* (Virginia copperleaf)
ECHCG – *Echinochloa crus-galli* (Barnyardgrass)
PANDI – *Panicum dichotomiflorum* (Fall panicum)

compared to other methods. The optimum height of straw mulch was found to be 10 cm. Unless applied over a barrier like newspaper, straw mulch, in the process of degradation, may tie up otherwise available soil nitrogen to crops affecting yield. Limited information is available on long term effects of plastic mulches on beneficial soil fauna. Removal of plastic mulch at the end of the season and proper disposal/storage are other limiting factors that may affect its widespread use in commercial production.

REFERENCES

Abdul-Baki, A., C. Spence, and R. Hoover. (1992). Black polyethylene mulch doubled yield of fresh-market field tomatoes. *HortSci.*, *27*:787-789.

Ashworth, S. and H. Harrison. (1983). Evaluation of mulches for use in the home garden. *HortSci*. 18(2): 180-182.

Chandran, R.S. (2014). Strategies for reduced herbicide use in Integrated Pest Management. *In* Integrated Pest Management: Pesticide Problems, Vol.3 Pimentel, D. and Peshin, R. (Ed.). Springer. *pp* 303-329.

Crnko, G.S., Stall, W.M., and J.M. White. (1992). Sweet corn weed control evaluations on mineral and organic soils. *Proc. Florida State Hort. Soc*. 105: 326-330.

Crutchfield, D.A., G.A. Wicks, and O.C. Burnside. (1985). Effect of winter wheat (*Triticium aestivum*) straw mulch level on weed control. *Weed Sci*. 34: 110-114.

Davis, J.M. (1994). Comparison of mulches for fresh-market basil production. *HortSci*. 29(4): 267-268.

Ghorai, A.K. and P.S. Bera. (1998). Weed control through organic mulching in pointed gourd (Trichosanthes dioica L.). *Indian J. Weed Sci*. 30 (1&2): 14-17.

Koike, Subbarao, K.V., Davis, R.M., and T.A. Turini. (2003). *Vegetable Diseases Caused by Soilborne Pathogens*. Univ. Calif. Div. Ag. Nat. Res. Publication 8099, Riverside, CA.

Ricotta, J.A. and J.B Masiunas. (1991). The effects of black plastic mulch and weed control strategies on herb yield. *HortSci*. 26(5): 539-541.

Ross, M.A. and C.A. Lembi. (1999). *Applied Weed Science*, 2nd ed. Prentice Hall, Inc. Upper Saddle River, NJ. 452 pp.

Tindall, J. A., R.B. Beverly, and D.E. Radcliffe. (1991). Mulch effect on soil properties and tomato growth using micro-irrigation. *Agronomy Journal,* 83, November-December: 1028-1034.