THE INFLUENCE OF MULCH TYPE ON YIELD OF PARSLEY AND CHIVE PRODUCTION IN THE U.S. VIRGIN ISLANDS.

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ABSTRACT

Studies were conducted to compare the effects of various mulch types on the growth and yield of parsley (*Petroselinum sativum*) and chives (*Allium schoenoprasum L.*). The mulch treatments were black fabric (weed barrier), silver plastic, white plastic, grass straw and a non-mulch bare treatment. Data on plant height, fresh and dry matter yields were collected for each crop at harvest. Weed population and weed weight were determined before each weeding operation, which was usually performed weekly. Results for both crops indicated that all mulches significantly reduced the number and biomass of weeds compared with the plots without mulch. The various mulch types also significantly influenced plant height, total fresh yields and dry matter yields. The straw mulch plots consistently produced higher yields of both fresh and dry parsley and chives. Production of chives from the white plastic mulch plots was the lowest of all the mulches and were similar to the plots without mulch. The results of these studies indicate that the use of locally available grass (straw) as mulch has potential for increasing production of parsley and chives in the Virgin Islands.

INTRODUCTION

Culinary herbs are important horticultural crops in the USVI. These crops are a major source of income for the many small-scale growers in St. Thomas and St. Croix. Because of their economic importance there is still a great need to conduct more research to provide information on ways to improve field production, processing and marketing of these crops.

Culinary herbs are grown and marketed fresh or dry. The preference in the local markets is for the fresh product but there is also a market for dried herbs. Additionally, as production increases and exceeds local demand is exported preferably in the dried form.

Substantial quantities of dried culinary herbs are imported annually into the USA Estimates by the USDA Foreign Agricultural Service showed that more than $349 million of dried condiments, seasonings and flavorings were imported into the USA in 1988 (USDA, 1989). In recent years, consumption of culinary herbs and spices has steadily increased in the USA. The trend of increased consumption of fresh, frozen, processed and dried culinary herbs and spices by Americans continues (Simon, 1990, Buzzanell and Gray, 1997). Factors that account for increased consumption include the rapid growth of the health food industry, interest in new foods and tastes, availability of more fresh herbs, advertising, and the expanding ethnic populations who crave for the foods and flavorings of their homeland.

The Caribbean Islands, including the USVI, have demonstrated the potential for commercial production of herbs and spices but more focused research needs to be conducted for improving the production capability. The need exists for the development of sustainable crop management practices, including to improve production levels and enhance culinary herb production through the use of organic mulches, composts, green manures, intercropping and micro-irrigation.

Mulches are used to suppress weeds, reduce erosion, conserve soil moisture and modify soil temperature and structure and improve aeration. The use of plastic mulches to control weeds is well documented. Palada et al., reported that plots of basil mulched with synthetic mulches had a smaller weed biomass expressed as dry weight than did the plots with organic mulches or without mulch. Organic mulches have, however, been found to be beneficial in weed control. Municipal solid waste compost was found to have potential as a viable mulch for weed control in vegetable crop alleys by (Roe et al., 1993). The benefits of weed control by mulches translate into savings of energy, labor, water and herbicides. Plastic film (polyethylene) mulches are the most commonly used mulch in the USVI. Black plastic mulch is popular among growers because it is easily available and has excellent weed control properties. A drawback to its use is the elevation in soil temperature, which though desirable in temperate areas, may not be beneficial to all crops grown in the tropical USVI.

Concern for the environment has been the main factor causing the focused attention on the use of environmentally sound farming systems. The use of organic mulches and manures is a significant feature in such systems. Organic mulches such as straw acts to buffer soil temperature whereas synthetic mulches permit more divergent temperature fluctuations (Ashworth and Harrison, 1983). Palada et al., (1995) reported that organic mulches were found to reduce the daytime temperature of the surface soil, 0-15 cm, by 2-6°C more when compared with synthetic mulches and 1-4oC more, compared to bare soil in the USVI.

Organic mulches provide additional benefits compared to synthetic mulches because they add organic matter and nutrients to the soil as they decompose. Following harvest of the crop they can be incorporated into the soil. This results in enhanced soil fertility and aeration. In a study evaluating two organic and six synthetic mulches, Ashworth and Harrison (1983) found that no single mulch produced consistently higher plant yield or better growth in a temperate environment. The organic mulches reduced the range of diurnal temperature changes and maintained cooler temperatures from noon until evening.

The use of polyethylene in the Virgin Islands has some drawbacks. Because it has to be imported, it is expensive and not always readily available. There is also the environmental concern regarding the disposal of used polyethylene mulch. This task has been reported to be an unpleasant job that adds to the farms labor cost (Anderson et al., 1995). It adds to the landfill and may also leave unsightly litter on the farm.

Research conducted on culinary herbs in the USVI has provided some indications of responses to mulching. The application of black polyethylene mulch in combination with microirrigation resulted in reduced yields of thyme from the mulched treatments due to a higher incidence of soil borne diseases (Collingwood et al., 1991; Palada et al., 1993a). In a comparison of synthetic and organic mulches Palada et al., (1995 and 1993b) reported positive responses from the use of organic mulches. Ram and Kumar (1997) obtained yield improvement of mint (*Mentha arvenis*) by the recycling of organic wastes (distillation wastes, pea straw and farmyard manure) as mulch.

In a comparison of black plastic, ground newspaper and wood chips on collard production, it was found that mulch type significantly affected collard yield. Fall collard yields were highest under bare ground or wood chips and spring yields were highest under black plastic (Guertal and Edwards, 1996). Tindall et al., (1991) compared the effect of mulch type (black plastic mesh and straw) and microirrigation on soil physical properties and growth of tomatoes in Georgia. Straw mulch resulted in a significantly greater water infiltration rate, and lower pH, bulk density, surface evaporation, soil temperature and matric potential than the plastic mulch. Yields were higher under the straw mulch compared to the plastic mulch. They concluded that straw mulches have the potential to improve tomato yields in high temperature environments, provided soil pH is controlled.

The objectives of this study were to determine the effect of various mulches on yield of chives and parsley; and observe the influence of mulches on weed growth.

MATERIALS AND METHODS

The study was conducted on the farm of a local grower in St. Croix, USVI. The soil is a Glynn gravelly loam (clayey, skeletal, mixed, superactive, isohyperthermic, typic, argiustoll). Treatments consisted of white on black polyethylene mulch, black fabric weed barrier, silver plastic film, grass mulch (hay) and a non-mulched bare soil treatment. All treatments included the application of microirrigation. The irrigation system was comprised of 15mm polyhose submains (Hardie Irrigation, El Cajon, CA) and laterals of 15ml New Hardie Tape with laser drilled orifices spaced 30 cm apart.

The experiment was established using randomized complete blocks with four replications. Each treatment plot was 1.2 m x 3.6 m, consisting of three rows 0.4 m apart. Plants were spaced 0.3 m within the rows. All plots were drip-irrigated to maintain soil moisture at 30 kPa. Tensiometers (Irrometer, Riverside, CA) were installed in each plot of two of the four replications. The grass mulch was applied to the soil surface in a 10cm layer.

All plots were hand weeded when necessary, usually on a weekly basis. Prior to each weeding operation weed samples were taken from the same area that would be used to obtain the harvest yield data. The fresh weight of the weed biomass was recorded and the samples were oven dried for dry matter determination.

Fertilizer was applied to all treatments at the rate of 100 kg N, 50 kg P and 50 kg K.ha^{-1}. Cow manure was used to provide 50 % of the N and ammonium sulfate, triple super phosphate and sulphate of potash to complete the required amounts of nutrients. Individual chive tillers were transplanted on December 23rd, 1996 and harvested on March 27th, 1997. Parsley seedlings were transplanted on March 27th, 1997, immediately following the harvesting of the chives. The parsley was harvested on May 30th, 1997. The data collected at harvest were plant height and fresh weight. The harvested materials were then placed in an oven at 65 °C and dried to a constant weight for dry matter determination.

RESULTS AND DISCUSSION

The plots were weeded on a regular basis which prevented weed seedlings from getting big enough to accumulate any appreciable biomass. The weed population data gives an indication of potential weeds that would be encountered if plots were not weeded as often as they were in this trial.

Problems were encountered regarding the use of the silver mulch. A combination of rainfall and high temperatures caused this mulch to lose the silver coating on a large percentage of the surface area. This caused light penetration through the transparent areas of the mulch and contributed to a high weed population under the plastic mulch in the chives trial. The mulch also started deteriorating before the trial was terminated. Prior to planting the parsley the silver plastic mulch was replaced and the loss of coating problem was less severe during the dry season and the shorter duration of this trial.

The chives suffered from a severe infestation of onion thrips (*Thrips tabaci*) and a root knot nematode problem developed during the latter stages of the parsley trial. A higher nematode infestation was observed in the synthetic mulch plots probably indicating that these mulches create a micro-environment that is ideal for the development of nematodes.

Table 1. Plant height (cm), fresh and dry yield (t.ha^{-1}) of chives grown with various mulches in the Virgin Islands.

Mulch Type	Plant Height	Fresh Wt.	Dry Wt.
Bare	43.6 c[z]	8.6 b	1.1 c
Weed Barrier	49.4 ab	12.3 ab	1.5 abc
Silver Plastic	46.0 bc	11.8 ab	1.6 ab
Straw	51.9 a	15.2 a	1.9 a
White Plastic	40.7 c	9.8 b	1.3 c

[z] Within columns, means followed by the different letters are significantly different by the LSD test ($P \leq 0.05$).

Chives

The application of mulches significantly ($P \leq 0.05$) affected plant height and the production of fresh and dried chives. Chives from the straw mulched plots with a mean height of 51.9 cm, were significantly taller than plants from all other treatments except weed barrier (Table 1). The shortest plants were from the white plastic mulch and bare soil plots.

The straw mulched plots produced the highest yield of fresh and dry chives. The yield of fresh and dried chives of 15.2 and 1.9 $t.ha^{-1}$, respectively from the straw mulched plots was significantly ($P \leq 0.05$) higher than yields from the white plastic mulched plots (9.8 and 1.3 $t.ha^{-1}$) and the plots without mulch (8.6 and 1.1 $t.ha^{-1}$). The 1.6 $t.ha^{-1}$ of dried chives from plots mulched with silver plastic was also significantly higher than from both the white plastic and bare soil treatments. These results indicate that grass straw used as a mulch may provide a more suitable environment for the growth of chives in the USVI than does white plastic. Despite the problems mentioned encountered with the silver mulch chive production from this treatment was similar to the straw mulch.

Table 2. Weed count ($\#/m^2$) and weed fresh and dry weight ($g.m^{-2}$) from chive plots grown with various mulches in the Virgin Islands.

Mulch Type	Number of	Fresh Wt. weeds	Dry Wt.
Bare	256 a[z]	936 a	233 a
Weed Barrier	32 c	65 c	11 b
Silver Plastic	62 b	329 b	67 b
Straw	48 bc	94 bc	19 b
White Plastic	27 c	38 c	7 b

[z] Within columns, means followed by the different letters are significantly different by the LSD test ($P \leq 0.05$).

The data in Table 2 show that mulching substantially reduced the number of weeds that occurred in each treatment. All mulched plots had a significantly (P? 0.05) lower number of weeds with less fresh and dry weed biomass than the plots without mulch, which had an accumulated weed count of $256/m^2$. The weed barrier and white plastic mulched plots had fewer weeds and a lower fresh biomass of weeds than plots with the silver plastic mulch. The dry weed biomass was similar for all mulch treatments. The performance of black colored mulches in controlling weeds was evident in this trial, as both the black weed barrier and the white on black plastic mulch were the most effective in controlling weeds. However, the ability of the straw mulch to control weeds was statistically similar to both mulches.

Parsley

The height of the parsley plants was affected by the application of mulches. Plants grown under the straw mulch, with a mean height of 26.2 cm were significantly (P? 0.05) taller than from all other treatments (Table 3). Parsley grown with the weed barrier mulch were taller (23.6 cm) than those grown in plots without mulch. The fresh parsley yield of 3392 $kg.ha^{-1}$ obtained from the straw mulched plots was significantly superior to the yield from the weed barrier plots which produced 2763 $kg.ha^{-1}$ (Table 3).

Table 3. Plant height (cm), fresh and dry yield (kg.ha^{-1}) of parsley grown with various mulches in the Virgin Islands.

Mulch Type	Plant Height	Fresh Wt.	Dry Wt.
Bare	20.8 c[z]	3125 ab	718 b
Weed Barrier	23.6 b	2763 b	622 b
Silver Plastic	21.4 bc	3392 ab	764 b
Straw	26.2 a	4858 a	1065 a
White Plastic	21.6 bc	3163 ab	695 b

[z] Within columns, means followed by the different letters are significantly different by the LSD test (P? 0.05).

The straw mulch plots also yielded the highest quantity of dried parsley (1065 kg.ha^{-1}). This amount was significantly higher than was obtained from all other plots. The yield responses obtained from this parsley trial has some similarities to those reported by Crossman et al., 1997 when they conducted an identical trial at a different location.

Table 4. Weed count (#/m^2) and weed fresh and dry yield (g.m^{-2}) from parsley plots grown with various mulches in the Virgin Islands.

Mulch Type	Number of weeds	Fresh Wt.	Dry Wt.
Bare	173 a[z]	32 a	10.0 a
Weed Barrier	23 b	5 b	2.0 b
Silver Plastic	5 b	1 b	0.6 b
Straw	23 b	8 b	3.0 b
White Plastic	7 b	1 b	0.2 b

[z] Within columns, means followed by the different letters are significantly different by the LSD test (P? 0.05).

The data in Table 4, shows that the application of mulches are beneficial in the control of weeds when growing parsley. The plots with mulch had a significantly (P? 0.05) lower amount of weed than all of the bare soil treatment. There was no significant differences between mulches for any of the parameters measured.

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