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THE EFFECT OF ORGANIC MULCHES ON THE GROWTH AND YIELD OF "WEST INDIES RED" HOT PEPPER (*CAPSICUM* SPP.)

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ABSTRACT: Organic mulches are available locally in bulk quantities and at reasonable prices. Such mulches represent an environmentally friendly alternative for weed control and tend to enhance soil conditions. Three organic mulches were applied to plots of West Indies red hot pepper (*Capsicum* spp.). Wood chips, green waste and coconut fibre were spread in a 7.5 cm thick layer on the surface before planting. A treatment without any mulch was used as control. Treatments were replicated in 4 blocks. Growth was assessed, primarily, by measuring plant height weekly. Harvesting was done continually up to six months after planting. The best total yield was obtained from plants mulched with green waste [6.90 Kg/plot] but this was not significantly different from the control. The wood chip mulch significantly reduced the growth and yield (4.25 Kg/plot, F pr=.02) as compared to in the control (6.44 Kg/plot).

Keywords: organic mulches, hot pepper, yield, growth.

Introduction

Weed control in the wet season can be extremely demanding on farm labour and, indeed, many small farmers opt not to try to farm in the wet season. It is a common observation to see lands in fallow on small farms in the wet season. It has been recognized, from previous analysis of the local pepper production systems, that there are constraints in labour use (Skeete, 2004) on local small farms. Discussions with some farmers suggest that reliable labour is difficult to secure and there is a problem of low efficiency. Low efficiency further increases the cost of an input which is already comparatively expensive.

Organic mulches are attractive alternatives for weed control not only in terms of the natural porosity and the beneficial effects on soil conditions, but also in terms of their environmental-enhancing properties. The recent operation of a recycling plant for organic waste materials is making these materials available in bulk quantities.

Synthetic mulches can create problems in the wet season for some crops since they are often not porous enough and build-up of moisture in soil becomes detrimental to crop growth.

The benefits of mulches for yield improvement in sub-optimal environments have been shown in work done Barbados. There was an increase in tomato fruit weight and size when using dry grass mulch (Smith, 1973).

Little is known on how the use of these materials as mulches affects the growth and yield of crops. The trial was therefore done to understand what effect the materials would have on the growth and yield performance of hot pepper.

Materials and Methods

The trial was established at Central Agronomic Research Station in July 2010. Graeme Hall falls in a low rainfall zone with an average of less than 1,143 mm annually. The soil belongs to the black associate grouping (Vernon &Carroll, 1996). A field of "West Indies red" pepper plants was grown following the recommendations of the Ministry of Agriculture. The trial was planted on standard 1.7 m (5'6") beds. Each plot had a single row of 10 plants at an intra-row spacing of 30 cm. Drip Irrigation was applied. The design was a randomised block with four treatments in four blocks including the control.

Three organic mulches were applied to the treatment plots. Wood chips, green waste and coconut fibre were spread in a 7.5 cm thick layer (about three chicken feed bags per plot) on the surface a week before planting. Because of the way they are processed, both green waste and coconut fibre contain a substantial amount of wood chips. A treatment without any mulch was used as control.

Early growth was assessed by measuring plant height and by counting the mature flowers per plant and the number of plants with mature flowers at six weeks. Yield was assessed from five harvests. One harvest was done on September 26th. After this initial bearing there was a period stretching until December, when frequent and unusually heavy rains and eventually a storm in November, suspended the plants in a non-bearing state. During this time bacterial spot and the impact of the storm, seriously hampered fruit-set. During this time a combination of fungicides were used to treat the disease. Plants recovered well and began normal growth in December.

Harvesting continued from early January, 2011. Five harvests were done. The total plot yield was compiled from each treatment plot. Fruit counts were done at each harvest. The weights were compiled and analysed using Genstat 5.3. software. The data were analysed on a single harvest basis as well as a total. After five harvests the trial was discontinued.

Soil sampling was done in September and in May and subjected to full chemical analysis at a laboratory in Florida.

Results and Discussion

Early Growth

In general early vegetative and reproductive growth were reduced in plots under mulch compared to the control. For hot pepper, the time taken for the plant to produce the first mature flower and the number of flowers produced in the earliest nodes are very good

indicators of the how well the plant has grown vegetatively in the early weeks after planting.

Wood chip mulch had the most negative effect on early growth. Plants growing under wood chips were slower to mature as seen from the number of plants/plot with mature flowers at 6 weeks (32.5%, F.pr=.061). Green waste at this early stage also significantly reduced the development of the plants (42.5% with flowers). Coconut fibre also had fewer plants with mature flowers (67.5%) at the time, but this was not statistically significant different from the control plot (85% with flowers) [see Table 1].

The green waste had a large proportion of wood chips added (to facilitate grinding) and this may explain why the green waste mulch initially created a plant response similar to that of the woodchips. Later the green waste had a more beneficial effect on yield.

A very similar trend was seen in the number of flowers per plant (Table 1). None of the plants under mulch had as many flowers per plant as in the control plot. The plants grown with wood chip mulch had significantly less flowers (3.6; FPr=.03) than the control (19.5). Those plants with green waste had 7.7 flowers and those with coconut fibre had 10.8 flowers.

Plants grown with wood chips and, to a lesser extent, with the green waste, had a chlorotic appearance in the early vegetative growth phase. All plants were shorter than in the control at eight weeks. Plants in plots under woodchip mulch were shortest (23.3 cm; F.pr=.008) as compared to the control at 36.5 cm. Plants grown with coconut fibre had a height of 27.1 cm at this stage.

The plants under green waste were shorter (32.1 cm) than the control, but the difference was not statistically significant. The green waste mulch seemed at this stage to be beginning to have a more beneficial impact on the plants compared to its earlier negative effects.

The negative impact on growth requires further investigation. However, it was noticed in the soil analysis that all of the mulches had a decreasing effect on the level of sulphur(S). Sulphate deficiency causes chlorosis and has an impact on protein synthesis [limits plant growth] (Marschner, 1986). It is known that the level of nitrogen (N) can influence the mineralisation of sulphate ions in soil, and that the dynamics are affected by the (C/N/S) nature of organic materials such as the mulches in this trial (Shahsavani, 2009).

There could possibly be other chemical factors in the mulches (wood chips and coconut fibre) that impacted on the early growth when freshly applied.

Yield

None of the mulched plots produced as many berries as the control plot (870). Of the three mulches, plants growing with green waste produced the largest number of berries

per plot (855). The plots growing with wood chip mulch produced a significantly less number of berries (504) than the control and green waste plots ([F Pr= .039] see Table 2). The differences for coconut fibre and green waste relative to the control were not statistically significant.

The total weight of berries was largest for the plots under green waste (6.9 Kg) [see Table 2]. The difference in yield for that plot versus the control (6.44 Kg) and the coconut fibre (5.46 Kg) was not statistically significant. The plots growing with wood chips yielded significantly less berries (4.25 Kg [F.Pr=02]) than the green waste and the control.

Given that the green waste plot produced less berries, but had a larger total weight per plot, it implies that the average weight of fruit was larger for this treatment. The difference would be an average weight of 8.07 g vs. 7.40 g. This suggests that the mulch improved the average size of the berries.

In trying to understand the possible mechanisms by which the green waste impacted positively on yield, it was noticed that the mulch improved the soil fertility status. There were significant increases in levels of phosphate, manganese and zinc (see Table 3). There was also a notable increase in soluble solids under green waste.

Phosphates in particular are known to be unavailable in the soils of Barbados (Vernon & Carroll, 1996). So this effect would make the green waste mulch very useful, given the 4x increase in phosphate

Effect on weed growth

Although the trial did not aim to measure the effectiveness of the mulches in controlling weeds, it is worth noting, that all mulches were effective in this respect. There was very little weed growth in the mulched plots for the lifespan of the trial, whereas it was necessary to weed the control plots on a monthly basis.

Table 1. The number of plants with mature flowers per plot, flowers per plant and heights of hot pepper plants grown with organic mulches

Mulch type	Number of Plants/ plot with mature flowers at 6 weeks	Number of Flowers/plant at 6 weeks	Height at 9 weeks after planting (cm)
Wood chips	3.3	3.6	23.3
Coconut fibre	6.8	10.8	27.1
Green waste	4.3	7.7	32.1
Control	8.5	19.5	36.5
F. Pr	.061	.03	.008
SED (9 df)	1.79	4.38	2.97
LSD	4.04	9.9	6.71

Table 2. The total number and total weight of berries harvested per plot of hot pepper plants grown with organic mulches.

Mulch type	Total number of berries harvested	Total weight of harvested berries
Wood chips	504	4.25
Coconut fibre	702	5.46
Green waste	855	6.90
Control	870	6.44
F. Pr	.039	.02
SED (9 df)	116	.71
LSD	263	1.61

Table 3. Comparison of key nutrients, CEC and soluble solids in soil samples taken from plots of hot pepper plants grown with organic mulches (three months after planting).

Mulch type	C.E.C	Soluble solids	P	N	S	Mn	Zinc
Wood chips	57.3	295	3.75	3.25	15.5	2.8	1.12
Coconut fibre	61.8	287	1.75	2.75	14.7	3.2	1.37
Green waste	55.9	342	9.25	2.25	19	5.7	1.3
Control	55.7	312	2.25	2.25	22.2	2.9	.85
F. Pr	.026	.014	.01	.03	.006	.093	.03
SED (9 df)							
LSD	4.04	31	4.2		3.8	2.6	.22

Conclusions

Green waste has the potential to improve hot pepper yield performance possibly by enhancing the nutrient status of the soil (phosphorus, manganese and zinc).

Green waste and coconut fibre applied on surface at a thickness of 7.5 cm are viable as a means of controlling weeds without significant impact on crop yield.

There is a need for further study on the negative impact on growth and yield in the initial stages. The decrease in the sulphate content is worth further examination.

There seems a need to allow these materials to decompose for 2-3 months before applying to some crops and possibly to boost them with strategic nutrients.

It may be necessary to add additional nitrogen and sulphur to maintain sulphate equilibrium after mulching. The dynamics of adding (N) are complex and require further study.

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