Advances in Science and Technology, Vol. 6, No. 1, March / April, 2012, pp 57 - 62

Weed Control in Field-Grown Feverfew in Southwest Mississippi

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(Submitted: March 9, 2012; Accepted: April 23, 2012)

Abstract

Feverfew (*Tanacetum parthenum*) is a composite aromatic plant with numerous small, daisy-like heads of yellow flowers with outer white rays. The stem is finely furrowed and hairy, about 60 cm high. This plant has the tendency to inhibit the release of serotonin and prostaglandins, the two inflammatory substances believed to contribute to the onset of migraine headaches. Additional benefits include the ability to lower blood pressure, stomach irritation and dizziness in humans. However, information on agronomic practices, especially weed management practices are needed to enhance its productivity and profitability by limited-resource farmers who benefit most from the scientific studies at Alcorn State University. Two field experiments were therefore used to determine the effect of two synthetic mulching materials ("Black Plastic", and "Weed Barrier") and one organic mulching material ("Pine Bark Nuggets") on the control of purple nutsedge (*Cyperus rotundus* L.) in field-grown feverfew plots. A tractor was used for raised bed preparations. Each raised bed, 6.1m. long and 1.2 m. wide received 230.0 gm of 13N-13P-13K fertilizer, based on soil test result. Six-weeks old seedlings were transplanted into each bed at 0.3m x 0.3m within-row plant spacing. Mulching was with either 6-mil "Black Plastic", "Weed Barrier" or "Pine Bark Nuggets" (Treatments). The unmulched beds represented the control. Both the treatments and the control were arranged in a Randomized Complete Block (RCB) experiment design, with five replications of each treatment and the control. Data were analyzed by the analysis of variance, and means separated by the Least Significant Difference (LSD) test procedure. A perfect purple nutsedge control (100%) was due to "Black Plastic" mulch application in 2003-2004 study period, but was due to both "Black Plastic" and "Weed Barrier" in 2004-2005. Plant survival was excellent, 90% and higher for both mulched and unmulched plots during both study periods. Both soil extractable nutrients and leaf mineral contents were higher during the 2004-2005 study period. Findings suggest that feverfew can be successfully grown as alternative crop in the fall planting season by limited-resource farmers in southwest Mississippi. A perfect control of purple nutsedge can be obtained with 6-mil Black Plastic used as a mulch in feverfew field plots, if other growth factors are not limiting.

Keywords: Herbs, Feverfew, mulching, plant growth, mineral composition

1.0 Introduction

Feverfew (*Tanacetum parthenum*) is a composite plant growing in every hedgerow, and possessing numerous small daisy-like heads of yellow flowers with outer white rays. The central yellow florets are arranged on a nearly flat receptacle. The stem is finely furrowed and hairy, about 60 cm high. It is a native to Southwest Europe but was brought to America originally as ornamental (Grieve, 1995). It is an aromatic plant with a strong and lasting odor, used externally as an insect repellent and for treating insect bites. It works to inhibit the release of serotonin and prostaglandins, the two inflammatory substances believed to contribute to the onset of migraine headaches (Greve, 1995). By the production of histamine, feverfew controls the inflammation that constricts the blood vessels in the head, and prevents blood vessel spasms which may contribute to headaches in humans. The plant is rich in sesquiterpene lactones, the principal one being parthenolide. The effectiveness of various feverfew preparations in inhibiting the release of serotonin from human blood platelets has been found to correlate well with parthenolide content in freeze-dried or air-dried whole feverfew leaf (Foster, 2009). Feverfew tea drunk cold, may relieve skin perspiration associated with migraines and has been used to stimulate appetite and improve digestion and kidney function. It may be more effective than nonsteroidal antiflammatories like aspirin in the reduction of frequency and severity of headaches. Additional benefits include the tendency to lower blood pressure, stomach irritation, dizziness and painful or sluggish menstruation (Grieve, 1995). It has been used for centuries for fevers, headaches, stomach aches, toothaches, insect bites, infertility, and problems with labor during childbirth. Recently, feverfew has been used for migraine headaches, rheumatoid arthritis, asthma, allergies, nausea, and vomiting (NCCAM, 2010).

Feverfew is one of the alternative crops being evaluated at Alcorn State University as a possible addition to some of the alternative crops being grown by limited-resource farmers in Mississippi. Originally from Southeastern Europe, feverfew is now common throughout Europe, Australia, and North America. It can be propagated from seed or cuttings, and prefers well-drained soil and sun. While the leaves are picked as required, the aerial parts as a whole are harvested in summer when the plant is in flower (Chevallier, 1996). Raising feverfew plants in the greenhouse using essentially the same float-bed system as that used to produce tobacco transplants, and then planting the seedlings in the field plots resulted in acceptable yields in Kentucky (Mundell et al., 2009). They observed that after harvesting the entire above-ground part of the plants the remaining stalk and root systems may over-winter, producing good yields in the following year. However, additional information on agronomic practices, especially weed management practices are needed to enhance its productivity and profitability. Most weeds are currently being controlled or prevented from becoming serious problems in the garden, chemically with herbicides. The control of both annual and perennial weeds with trifularin + bentazon combinations has been reported as excellent (Teasdale and Frank, 1992). Metolachlor, alone or in combination with clomazone controlled or suppressed yellow nutsedge and rice flat sedge in sweet potato plots (Porter, 1993). Combined application of amiben + enide generally increased percent goose grass and nutsedge control in hot pepper plot than their single applications (Igbokwe *et al*., 1988). Postemergence application of a mixture of paraquat, metribuzin, and metolachlor between rows of mulch provided good weed control with no injury to tomatoes and proved to be a profitable treatment for small-farm, fresh market production (Teasdale and Colacicco, 1985).

Although weeds in crop fields have been suppressed or controlled chemically, there has been increased general concern in the scientific and policy arena regarding the sustainability of the current conventional use of chemical pesticides. The undesirable environmental and health trade-offs with chemical intensive agriculture are becoming apparent (Adams, 1986). Since no herbicide has been labelled for weed control in feverfew plots, despite the fact that weed management is one of the most critical management areas for organic growers (Waltz, 1999), the focus of this study was to determine the effect of one organic mulch ("Pine Bark Nuggets")and two synthetic mulches ("Black Plastic" and "Weed Barrier") on purple nutsedge control and feverfew growth potential and quality.

2.0 Materials and Method

Two field experiments were used to determine the effect of three mulching materials ("Black Plastic", "Weed Barrier" and "Pine Bark Nuggets") on purple nutsedge (*Cyperus Rotundus L.*) control in field-grown feverfew (*Tanacetum Parthenum*). The field studies were initiated during the 2003-2004 and 2004-2005 Fall growing seasons. The soil was a Memphis silt loam (Typic Hapludalf, silty, mixed, thermic. Initial soil fertility levels were high for phosphorus, potassium and calcium, but very high for magnesium. Soil acidity (P^H), cation exchange capacity (Meq/L) and organic matter (%) were 7.3, 13.3 and 1.0, respectively.

During the 2003-2004 study period a tractor was used for disking (2 times) and bed preparations. Each raised bed, 6.1 m long and 1.2 m wide received 230 gm of 13N-13P-13K fertilizer based on soil test result. The fertilizer was incorporated into the soil during raised bed preparation. Each bed which was 5.1 cm high was surrounded by uncultivated alley 0.9 m. wide to prevent the overlapping of treatment effects. Six-weeks old seedlings raised at the Alcorn State University greenhouse were transplanted into the beds at 0.3 m x 0.3m within-row plant spacing. Beds were either protected with 6-mil "Black Plastic", "Weed Barrier", or "Pine Bark Nugget" (Treatments) or unprotected (Control). Treatments were arranged in Randomized Complete Block (RCB) experiment design and replicated five times. Moisture applications were by either hand (watering can), overhead sprinklers or natural rainfall. No pesticide was used in these studies. Data collection on weed infestations, plant growth and leaf mineral compositions were from the middle area (3.0m long and 1.2m wide) of each row, within each block.

Weed infestation was the total number of purple nutsedge present during each monthly count. Plant growth was an average of the plant height, plant width, branches per plant, stem diameter, shoot dry weight, root length, root dry weight and root dry matter from 10 randomly selected plants from the middle of each row, within each block. Plant survival was the total number of test plants present at the end of each study period. Representative leaf samples taken before flower formation were oven-dried at 70°C for 24 hours, ground in a Wiley mill (20 mesh) and used for mineral composition determination.

During the 2004-2005 study period field preparations and all other agronomic production practices were as for the 2003-2004 study period. Data collection on plant growth components, leaf sample preparation and analysis were also as for the first study period. All data were subjected to the analysis of variance, and means separated by the least significant difference (LSD) test (Steele and Torrie, 1980).

3.0 Results

Soil extractable nutrients, soil reaction, and soil organic matter contents before and after the study are reported in Table1. In 2003 (before the initiation of this study) macronutrient levels were high for phosphorus, potassium, and calcium, but very high for magnesium, based on soil test results. Soil reaction (P^H) and soil organic matter (%) were 7.3 and 1.0 respectively. In 2005 (after the second study period), mulching effect on soil fertility levels were highly significant at ($P<0.01$) except for organic matter which was significant at ($P<0.05$) only. In general, Black Plastic mulch had highest levels of phosphorus, potassium, calcium, and soil pH compared to other treatments and the control. Soil organic matter was highest due to Pine Bark Nuggets mulch. Mean values were highest for mulched plots compared to the control, except for soil extractable potassium.

The effect of mulch applications on purple nutsedge control is reported in Table 2. A perfect purple nutsedge control (100%) was due to Black Plastic mulching application during the 2003-2004 study period. In 2004-2005, both Black Plastic and Weed Barrier had perfect control (100%) of purple nutsedge. The overall nutsedge infestations were lower during the second study period compared to the first. Unmulched plots (control) had greatest infestations during both study periods.

The effect of mulch applications on feverfew plant survival and growth components is reported in Table 3. The non-significant percent plant survival was excellent (more than 90%) for both mulched and unmulched plots. Both the number of branches, and shoot fresh weight per plant were highest (25.6 and 0.15 Kg/Pl)due to Black Plastic mulch. The number of branches was lowest (10.8) due to Pine Bark mulch, whereas shoot fresh weight was lowest (0.09 Kg/Pl) due to the control during the first period of study. In 2005 shoot fresh weight was highest (0.64 gm/plant) due to Black Plastic mulch, and lowest (0.40 Kg/Plant) for the Pine Bark mulch application. Plant growth components generally showed some increase for the second period of study compared to the first.

The effect of mulch application on leaf macronutrient content is reported in Table 4. Mulching effect was not different during both study periods, except for magnesium, which had significant variations during the second study period. The level was highest (0.31%) due to Black Plastic and weed Barrier applications, but lowest for the control. In general, values were higher for the second study period compared to the first.

4.0 Discussions

Improved soil extractable nutrient levels, soil reaction, and soil organic matter at the end of the second study period could be due to the additional fertilizer applications after the first study period, possible prevention of nutrient loss by leaching or runoff by mulching materials, or by nutrient additions during the incorporation of unharvested plant residues into the soil at field preparations. The thickness of Black Plastic mulch (6-mil) could be the reason for its ability to control nutsedge penetration and from becoming a problem to feverfew growth and development during both study periods. Hand-pulling and discarding pulled weeds after counting could be the reason for the reduction in nutsedge infestations during the second study period. This could also account for better plant growth components, and leaf mineral compositions during the same period.

3.1 Soil Properties

Table 1: Soil Nutrients, Soil Reactions and Soil Organic Matter

Treatment(Mulching)	Extractable Nutrients (Kg/ha)				Soil Reaction (pH)	
	P	K	Ca	Mg	Organic Matter (%)	
			2003[X]			
Control	1064	280.0	4314.2	855.7	7.3	1.0
			2005[Y]			
Black Plastic	169.1	221.7	5062.8	843.0	7.7	1.2
Weed Barrier	134.8	193.8	4506	899.8	7.6	1.3
Pine Bark Nugget	115.7	188.4	4117.5	905.7	7.4	1.5
Mean	139.9	201.3	4562.1	882.8	7.6	1.3
LSD, 5%	7.9	9.6	115.0	31.5	0.1	0.2
LSD,1%	12.0	14.5	174.2	47.7	0.2	NS

[X] Soil test result before the initiation of the study.

[Y] Soil test result at the end of the second year of study.

3.2 Nutsedge Control

Table 2: Purple Nutsedge Count

			Number per Treatment			
			2003-2004[X]			
Treatment (Mulching)	11/30/03	12/29/03	1/29/04	2/27/04	3/2804	Overall
Black Plastic	0.0	0.0	0.0	0.0	0.0	0.0
Weed Barrier	0.0	0.0	8.3	0.0	27	11.0
Pine Bark Nugget	34.3	30.0	20.0	0.0	17.0	101.3
Control	38.3	33.7	23.3	0.0	20.3	115.7
Mean	18.2	15.6	12.9	0.0	10.0	57.0
LSD, 5%	11.4	15.6	6.0	NS	2.4	17.0
LSD,1%	1.8	1.5	NS	1.5	2.7	2.6
			2004-2005[Y]			
(Mulching)	11/12/04	12/14/04	1/14/05	2/14/05	3/14/05	Overall
Black Plastic	0.0	0.0	0.0	0.0	0.0	0.0
Weed Barrier	0.0	0.0	0.0	0.0	0.0	0.0
Pine Bark	3.7	1.0	0.0	3.3	4.3	12.3
Control	19.7	3.0	0.0	4.0	5.7	32.3
Mean	5.9	1.0	0.0	1.8	2.5	11.2
LSD, 5%	1.2	1.0	NS	1.0	1.8	1.8
LSD, 1%	1.8	1.5	NS	1.5	2.7	2.6

[X] Weed counts from 3.6 sq. meter area per row were at different stages of plant growth throughout the first study period.

[Y] Weed counts from 3.6 sq. meter area per row were at different stages of plant growth throughout the second study period.

3.3 Plant Growth

Table 3: Feverfew Plant survival and growth Components

Treatment (Mulching)	Plant survival (%)	Plant Height (cm)	Growth Components Plant Width(cm)	Shoot Fresh Weight Kg/Plant	Branches (#/Plant)
			2003-2004[X]		
Black Plastic	98.9	63.5	35.3	0.15	25.6
Weed Barrier	100.0	54.8	30.6	0.11	22.0
Pine Bark	97.0	60.7	27.0	0.11	10.8
Control	100.0	50.8	28.4	0.09	11.5
Mean	99.0	57.5	30.3	0.12	17.5
LSD, 5%	NS	NS	NS	0.03	3.9
LSD,1%	NS	NS	NS	NS	5.5
			2004-2005[Y]		
Black Plastic	100.0	101.4	61.6	0.64	14.7
Weed Barrier	100.0	101.5	55.0	0.51	14.0
Pine Bark	95.0	91.4	50.5	0.40	12.1
Control	97.0	100.0	51.9	0.49	13.4
Mean	98.0	98.6	54.8	0.51	13.6
LSD, 5%	NS	NS	NS	0.13	NS
LSD, 1%	NS	NS	NS	NS	NS

[X] Values are averages for the treatments and control at the end of the first study period

[Y] Values are averages for the treatments and control at the end of the second study period.

3.4 Mineral Composition

Table 4: Feverfew Leaf Mineral Composition

Treatment (Mulching)	N	P	Leaf Macronutrients (%) K	Ca	Mg	S
			2003-2004[X]			
Black Plastic	1.6	0.28	3.1	0.48	0.15	0.10
Weed Barrier	1.8	0.34	3.9	0.55	0.21	0.12
Pine Bark Nugget	1.7	0.22	2.2	0.45	0.18	0.11
Control	1.7	0.30	2.3	0.47	0.20	0.12
Mean	1.7	0.29	2.9	0.49	0.19	0.11
LSD, 5%	NS		NS	NS	NS	NS
LSD,1%	NS		NS	NS	NS	NS
			2004-2005[Y]			
Black Plastic	2.6	0.43	7.1	0.42	0.31	0.19
Weed Barrier	3.2	0.47	9.0	0.52	0.31	0.20
Pine Bark Nugget	5.5	0.42	8.5	0.53	0.21	0.24
Control	5.0	0.49	8.5	0.52	0.17	0.24
Mean	4.1	0.45	8.3	0.50	0.25	0.22
LSD, 5%	0.8	NS	NS	NS	0.41	NS
LSD, 1%	1.1	NS	NS	NS	NS	NS

[X] Values represent leaf mineral compositions before flowering during the first study period.

[Y] Values represent leaf mineral compositions before flowering during the second study period.

4.0 Discussions

Improved soil extractable nutrient levels, soil reaction, and soil organic matter at the end of the second study period could be due to the additional fertilizer applications after the first study period, possible prevention of nutrient loss by leaching or runoff by mulching materials, or by nutrient additions during the incorporation of unharvested plant residues into the soil at field preparations. The thickness of Black Plastic mulch (6-mil) could be the reason for its ability to control nutsedge penetration and from becoming a problem to feverfew growth and development during both study periods. Hand-pulling and discarding pulled weeds after counting could be the reason for the reduction in nutsedge infestations during the second study period. This could also account for better plant growth components, and leaf mineral compositions during the same period.

5.0 Conclusions

Feverfew (*Tanacetum parthenum*) can be successfully grown as a Fall crop by limited resource farmers in southwest Mississippi. Excellent control of purple nutsedge can be provided with 6-mil "Black Plastic" and "Weed Barrier" used as mulch in field plots. Hand-pulling, hoeing and discarding residues from plots will reduce nutsedge infestations in subsequent years if the plots remain in production. Significant reduction in nutsedge infestation could lead to better feverfew plant growth and leaf mineral contents. Using 6-mil black plastic as mulch could be more economical when used for more than one growing season at a time. Incorporating crop residue into the soil during field preparation will improve soil nutrient levels and plant nutrient uptake.

Acknowledgement

The authors extend their sincere appreciation to Dr. M. Christopher Brown II, President, Alcorn State University, Dr. Samuel White, Provost for Academic Affairs, and Dr. Berry Bequette, Dean, School of Agriculture, Research, Extension and Applied Sciences at this University for supporting research on alternative crops. Special thanks are extended to USDA/NIFA for supporting agricultural research at this institution.

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