Indian Journal of Weed Science **52**(3): 292–295, 2020

Print ISSN 0253-8040 Online ISSN 0974-8164

Effect of plant extracts and rice straw mulch on weed growth and yield of groundnut

N. Sai Geethika, D. Subramanyam*, S. Tirumala Reddy and V. Umamahesh

Sri Venkateswara Agricultural College, Tirupati, Andhra Pradesh 517 502, India

**Email: subbuagro37@gmail.com*

Article information

DOI: 10.5958/0974-8164.2020.00058.1

Type of article: Research note

Received : 17 April 2020
Revised : 14 July 2020
Accepted : 16 July 2020

Key words
Plant extracts

Weed dry weight

Weed control efficiency

Yield

ABSTRACT

Sorghum (*NJ-2647*), sunflower (*NDSH-1012*) and rice (*NLR-34449*) were grown up to physiological maturity and harvested for preparing plant extracts during *Kharif* 2017 at Sri Venkateswara Agricultural College, Tirupati, Andhra Pradesh. Plant parts of *Parthenium hysterophorus*, *Lantana camera* and *Cyperus rotundus* were collected from the non-cropped area at flowering. The chopped material of above plants were soaked separately in distilled water for 24 hours at room temperature of 21^{0}C at a ratio of 1:10 (w/v) and the same was filtered through 10 and 60 mesh sieve separately. A field experiment was conducted during *Rabi* 2017-18 in a randomized block design with 10 treatments to evaluate the performance of different plant extracts each applied at 15 L/ha at 15 and 30 DAS and rice straw mulch 5 t/ha for weed management in groundnut. The application of rice straw mulch 5 t/ha was found to be the best followed by sunflower extract spray for obtaining higher pod yield and maximum net returns, besides effective control of weeds in groundnut in view of sustainability and reduce the load of herbicides in the soil, however pre-emergence application of pendimethalin 1.0 kg/ha + HW at 30 DAS produced higher pod yield and net returns.

Groundnut (*Arachis hypogaea* L.) is known as poor man's cashew nut and an important oil seed crop grown around the world as well as in India. Among the several factors limiting the productivity of groundnut, weeds are considered to be one of the major yield limiting factors due to its short stature and slow initial growth. Heavy weed infestation in groundnut reduces the pod yield as high as 24 to 70% and first three to four weeks of crop growth period was critical for weed control in groundnut grown on sandy loam soils of Varanasi, Uttar Pradesh (Singh *et al.* 2014). Generally, weeds are controlled through hand weeding in groundnut, but it is expensive and laborious. Herbicide application is expensive and poses detrimental effect on the environment. In recent years, research attention is now being focused on reducing the dependence upon synthetic herbicides and finding alternative strategies for weed management in sustainable and organic agricultural systems.

Allelopathy offers potential for bio-rational weed control through production and release of allelochemicals from leaves, stem, root, flower and seeds of living or decomposing plant materials (Hien *et al.* 2015). Number of secondary metabolites / allelomones is being screened for herbicidal properties from different plants with considerable crop selectivity, which can be used directly in the form of aqueous plant extracts and indirectly gives clues for developing analogs of herbicides. Kandhro *et al.* (2015) observed that the application of allelopathic plant extract of sunflower 25 L/ha twice at 15 and 30 DAS resulted in reduced weed density in cotton at clay loam soils of Peshwar, Pakistan. There is a scope for use of certain weed water extracts for controlling weeds due to presence allelopathic chemicals. Foliar application of allelopathic water extracts of *P. hysterophorus* 24 L/ha in combination with reduced doses of bromoxynil 150 g/ha significantly reduced the weed density in wheat (Baloach *et al.* 2012). In this context, the present investigation was planned to study the performance of different organic weed management strategies by including plant water extracts and rice straw mulch to control mixed weed flora in groundnut on sandy loam soils.

Sorghum (*NJ-2647*), sunflower (*NDSH-1012*) and rice (*NLR-34449*) were sown in wet land farm during *Kharif 2017* in an area of 20 m^2 each by adopting all the package of practices of Acharya N.G.

Ranga Agricultural University. These crops were harvested at physiological maturity and shade dried for 10 days and stored. Plant parts of *Parthenium hysterophorus* L. and *Lantana camara* L. were collected at flowering stage and dried under shade conditions. Tubers of *Cyperus rotundus* L. were collected from the soil, cleaned and dried under shade. The dried material of entire plant parts above the ground and tubers of purple nutsegde were chopped with power operated chaff cutter into 2 cm pieces, separately. The chopped plant material was soaked in distilled water for 24 hours at room temperature of 21^0C at a ratio of 1:10 (w/v) and the same was filtered through 10 and 60 mesh sieve separately. These plant extracts were boiled at 100^0 C to concentrate solution up to 20 times for easy handling and application.

A field experiment was conducted at wetland farm, Sri Venkateswara Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh, to study the performance of different plant extracts and rice straw mulch for weed management in groundnut during *Rabi* 2017-18. The soil was sandy loam in texture, neutral in soil reaction (7.70), electrical conductivity (0.65 dS/m), low in organic carbon (0.23%) and available nitrogen (128 kg/ha), medium in available phosphorus (12 kg/ha) and available potassium (225 kg/ha). The groundnut variety *'TCGS 1043' (Dharani)* was sown with a spacing of 22.5 x 10 cm on 22 December, 2017. The experiment was laid out in randomized complete block design and replicated thrice with ten weed management practices, *viz*. plant extracts of sorghum, sunflower, rice straw, *Parthenium, Lantana* and purple nutsedge each applied at 15 L/ha at 15 and 30 DAS, rice straw mulch 5 t/ha, pre-emergence application of pendimethalin 1.0 kg/ha supplemented with HW at 30 DAS, post-emergence application of imazethapyr 75 g/ha and unweeded check. The required quantities of filtered concentrated plant extracts, imazethapyr and pendimethalin were applied as per the treatments by using spray fluid of 500 L/ha with the help of knapsack sprayer fitted with flat fan nozzle. Rice straw mulch was applied carefully in between the rows at 5 DAS. The crop was supplied with recommended dose of fertilizer *i.e.* 30 kg N, 40 kg P and 50 kg K/ha through urea, single super phosphate and muriate of potash, respectively. The category wise weed density and weed dry weight was estimated at harvest. Weed control efficiency and weed index was calculated as per the method suggested by Mani *et al.* (1973) and Gill and Kumar (1969), respectively. The data on weed density and dry weight was subjected to square-foot transformation before statistical analysis. The yield attributing parameters like number of filled pods/ plant, pod yield, haulm yield and test weight were recorded at harvest.

Weed growth

The predominant weed flora observed in groundnut field were *Cyperus rotundus* (45%), *Digitaria sanguinalis* (15%), *Borreria hispida* (7%), *Digera arvensis* (6%), *Boerhavia erecta*(5%), *Cleome viscosa* (3%), *Dactyloctenium aegyptium* (4%), *Trichodesma indicum* (4%), *Phyllanthus niruri* (4%) and other weeds (7%) in unweeded check plots. All the weed management practices significantly influenced the density and dry weight of grasses, sedges, broad-leaved weeds and weed control efficiency (**Table 1**). The lowest density and dry weight of grasses were recorded with pre-emergence application of pendimethalin 1.0 kg/ha+ HW at 30 DAS than rest of the treatments. Among the organic weed management practices, rice straw

Table 1. Effect of different plant extracts on weed density, weed dry weight and weed control efficiency in groundnut during *Rabi* 2017-18

Weed management practice	Weed density (no./m^2)				Weed dry weight (g/m^2)				WCE
	Grasses	Sedges	BLWs	Total	Grasses	Sedges	BLWs	Total	(%)
Sorghum extract 15 L/ha (15 and 30 DAS)	5.57(30)	5.94(34)	5.69(31)	9.83(95)	4.76(22)	5.07(25)	4.87(20)	8.22(67)	57.4
Sunflower extract 15 L/ha (15 and 30 DAS)	4.55(20)	5.74(32)	5.13(25)	8.80(77)	4.63(20)	4.86(23)	4.51(19)	7.92(62)	61.6
Rice straw extract 15 L/ha (15 and 30 DAS)	6.03(35)	6.76(45)	5.92(34)	10.70(114)	5.16(26)	5.32(27)	4.99(24)	8.79(77)	52.6
Parthenium extract 15 L/ha (15 and 30 DAS)	6.43(40)	7.09(49)	6.40(40)	11.43(129)	5.32(27)	5.81(33)	5.23(26)	9.33(86)	46.6
Lantana extract 15 L/ha (15 and 30 DAS)	5.69(31)	6.51(41)	5.80(33)	10.31(105)	4.88(23)	5.27(27)	4.60(23)	8.38(73)	57.0
Purple nutsedge extract 15 L/ha (15 and 30 DAS)	6.19(37)	7.07(49)	6.25(38)	11.20(124)	5.41(28)	5.61(30)	5.14(25)	9.20(83)	48.1
Rice straw mulch 5 t/ha (5 DAS)	4.51(19)	4.93(23)	4.54(20)	7.93(62)	3.41(11)	4.50(19)	3.07(8)	6.23(38)	76.3
Pendimethalin 1.0 kg/ha + HWs (1 and 30 DAS)	3.21(9)	4.65(21)	3.27(10)	6.34(40)	2.64(6)	4.06(15)	2.55(5)	5.23(26)	83.4
Imazethapyr 75 g/ha (20 DAS)	4.12(16)	4.65(21)	3.65(12)	7.04(49)	3.22(9)	4.85(22)	3.38(10)	6.55(41)	73.8
Unweeded check	9.26(85)	11.47(131)	9.33(86)	17.37(301)	6.07(36)	8.38(69)	7.61(57)	12.75(162)	-
LSD (p=0.05)	0.12	0.22	0.16	0.85	0.38	0.42	0.34	0.31	

Figures in the parentheses are the original values and subjected to square root transformation; BLWs: Broad-leaved weeds

mulch 5 t/ha recorded significantly lesser density of grasses, which was at par with sunflower extract spray 15 L/ha applied at 15 and 30 DAS, but the former treatment recorded significantly lesser dry weight of grassy weeds than later. The lowest density of sedges was recorded with rice straw mulch 5 t/ha, which was at par with pendimethalin 1.0 kg/ha + HW at 30 DAS. Among the plant extracts, sunflower extract recorded significantly lesser density and dry weight of sedges followed by sorghum extract spray each sprayed at 15 L/ha at 15 and 30 DAS. Iqbal *et al*. (2007) also stated that sunflower extract at 12 and 15 l/ha alone or mixed with reduced rate of glyphosate decreased the density of *C. rotundus* by 59 to 99% in cotton. Significantly lesser density and dry weight of broad-leaved weeds were recorded with pre-emergence application of pendimethalin 1.0 kg/ha + HW at 30 DAS, however it was comparable with rice straw mulch 5 t/ha. Among the plant extracts, sunflower extract spray 15 L/ha recorded significantly lesser density of broad-leaved weeds followed by sorghum extract. Among the plant extracts, sunflower extract recorded significantly lower density and dry weight of total weeds, which was in parity with sorghum extract. The highest density and dry weight of total weeds was noticed with parthenium extract spray followed by purple nutsedge extract spray, among the plant extracts.

The highest weed control efficiency was computed with pre-emergence application of pendimethalin 1.0 kg/ha + HW at 30 DAS followed by post-emergence application of imazethapyr 75 g/ha. Among organic weed management practices, rice straw mulch 5 t/ha registered maximum weed control efficiency followed by sunflower extract 15 L/ha applied twice at 15 and 30 DAS. Rice straw mulch might have increased the albedo and decreased the solar energy flux to the soil, which in turn reduce the germination and dry weight of weeds (Lalitha *et al.* 2010). Foliar application of aqueous extract of sorghum and sunflower each 15 L/ha at 20 DAS reduced the density of *Trianthema portulacastrum* and C. *rotundus* by 45.8 and 56.0%, respectively over control in maize grown on sandy clay loam soils. The lowest weed control efficiency was calculated with parthenium extract spray followed by purple nutsedge extract spray.

Yield attributes and yield

Among the weed management practices, the highest values of yield components, *viz.* number of filled pods/plant, hundred pod weight and hundred kernel weight were recorded with pre-emergence application of pendimethalin 1.0 kg/ha + HW at 30 DAS followed by post-emergence application of imazethapyr 75 g/ha (**Table 2**). Among the organic weed management practices, the highest values of above yield parameters were registered with rice straw mulch 5 t/ha followed by sunflower extract 15 L/ha applied twice at 15 and 30 DAS. This might be due to maintenance of better source-sink relations owing to adequate availability of growth resources as a result of less weed competition. The positive effect of rice straw mulch on growth and yield attributes in soybean was also reported by Eid *et al.* (2013) with rice straw 15 t/ha. Parthenium extract 15 L/ha applied twice recorded significantly lesser values of above yield components of groundnut which were at par with purple nutsedge extract spray, among the plant extracts.

All the chemical weed management practices recorded significantly higher pod and haulm yield than organic weed management practices due to maintenance of weed free environment at early stages of crop growth which might have increased yield components. Among the organic weed management practices, rice straw mulch 5 t/ha produced significantly higher pod yield than rest of the

Table 2. Effect of different plant extracts on yield attributes, yield and economics of groundnut during *Rabi* 2017-18

Weed management practice	No. of filled pods/plant	100- pod weight (g)	100-kernel weight (g)	Pod yield (t/ha)	Haulm yield (t/ha)	Harvest Index (%)	Weed index (%)	Net returns (x10^3 ₹/ha)	B:C ratio
Sorghum extract 15 L/ha (15 and 30 DAS)	11.4	129.1	53.87	1.85	2.49	42.60	33.40	39.69	2.08
Sunflower extract 15 L/ha (15 and 30 DAS)	11.7	138.3	54.63	1.90	2.51	43.12	31.34	43.33	2.23
Rice straw extract 15 L/ha (15 and 30 DAS)	10.7	123.9	52.57	1.61	2.46	39.60	41.78	30.37	1.83
Parthenium extract 15 L/ha (15 and 30 DAS)	10.0	118.9	46.87	1.39	2.38	36.95	49.68	21.21	1.57
Lantana extract 15 L/ha (15 and 30 DAS)	10.9	126.5	52.67	1.72	2.48	40.85	38.09	34.17	1.92
Purple nutsedge extract 15 L/ha (15 and 30 DAS)	10.3	122.6	51.53	1.42	2.39	37.29	48.82	21.76	1.58
Rice straw mulch 5 t/ha (5 DAS)	12.5	143.9	55.87	2.09	2.58	44.48	24.42	44.61	2.15
Pendimethalin 1.0 kg/ha + HW (1 and 30 DAS)	13.3	146.1	59.37	2.77	2.65	51.10	-	71.86	3.04
Imazethapyr 75 g/ha (20 DAS)	11.8	144.0	56.87	2.55	2.60	49.53	7.88	67.41	2.85
Unweeded check	8.9	108.5	42.20	1.32	2.17	37.68	52.51	19.65	1.56
LSD (p=0.05)	0.49	5.60	2.25	0.16	0.11	1.73	-	3.96	0.12

treatments (**Table 2**). The increased pod yield was possibly due to better weed control which resulted in better growth parameters and in turn increased the yield attributes and higher pod yield. The next best organic weed management practice in recording higher pod yield with sunflower extract spray, which was at par with sorghum extract spray each applied at 15 L/ha applied at 15 and 30 DAS. Naeem *et al.* (2016) also reported that application of sorghum and sunflower extracts 15 L/ha at 20 DAS in maize increased the grain yield by 50.4%.The highest harvest index (51.1%) in groundnut was calculated with pre-emergence application of pendimethalin 1.0 kg/ha + HW at 30 DAS, which was comparable with post-emergence application of imazethapyr 75 g/ha. Among the organic weed management practices, rice straw mulch 5 t/ha recorded significantly higher harvest index (44.48 %), which was comparable with sunflower extract spray. The increased harvest index with increased weed control efficiency might be due to increased availability of growth resources and partitioning ability of photosynthates, which lead to increased pod yield. Similar results were also reported by Marwat *et al.* (2008).The lowest weed index was estimated with rice straw mulch 5 t/ha followed by sunflower extract spray 15 L/ha as these weed management practices recorded significantly lesser density and dry weight of weeds which in turn increased the pod yield. Rahaman and Mukherjee (2012) also recorded lower weed index with application of rice straw mulch 8 t/ha in jute. Application of rice straw mulch 5 t/ha recorded significantly higher net returns and benefit-cost ratio followed by sunflower and sorghum extracts each applied at 15 L/ha in descending order, among the organic weed management practices. The experimental results indicated clearly that the application of rice straw mulch 5 t/ha and sunflower extract spray 15 L/ha twice at 15 and 30 DAS were found to be the best for broad-spectrum weed control and obtaining higher pod yield including maximum net returns in groundnut in view of sustainability and reduce the load of herbicides in the soil.

REFERENCES

Baloch MS, Noor K, Khan EA, Khan MA, Awan IU, Sadiq M and Aslam M. 2012. Allelopathic effect of congress grass on weeds and yield of wheat. *Pakistan Journal of Weed Science Research* **18**(3): 307–318.

Eid AR, Bakry BA and Taha MA. 2013. Effect of pulse drip irrigation and mulching systems on yield, quality traits and irrigation water use efficiency of soybean under sandy soil conditions. *Agricultural Sciences* **4**(5): 249–261.

Gill GS and Kumar K. 1969. "Weed Index" a new method for reporting weed control traits. *Indian Journal of Agronomy* **14**: 96–78.

Hien LT, Park SH, Park YJ, Won OJ, Hwang JB, Park SU and Park KW. 2015. *Research on Crops* **16**(4): 657–662.

Iqbal J, Cheema ZA and An M. 2007. Intercropping of field crops in cotton for management of purple nutsedge (*Cyperus rotundus L.*). *Plant and Soil* **300**: 163–171.

Kandhro MN, Memon HR, Ansari MA and Shah MA. 2015. Effect of allelopathic water extract of sorghum and sunflower on weed mortality and cotton yield. *Sarhad Journal of Agriculture* **31**(3): 165.

Lalitha M, Thilagam VK, Balakrishnan N and Monsour M. 2010.Effect of plastic mulch on soil properties and crop growth–A review. *Agricultural Reviews* **31**: 145–149.

Mani VS, Malla ML, Gautam KC and Bhagavandas. 1973. Weed killing chemicals in potato cultivation. *Indian Farming* **23**: 17–18.

Marwat KB, Khan MA, Anwar N and Amin A. 2008. *Parthenium hysterophorus*, a potential source of bioherbicide. *Pakistan Journal of Botany* **40**(5): 1933–1942.

Naeem M, Mahmood A, Ihsan MZ, DaurI , Hussain S, Aslam Zand Zamanan SA. 2016. *Trianthema portulacastrum* and *Cyperus rotundus* interference in maize and application of allelopathic crop extracts for their effective management. *Planta Daninha* **34**(2): 209–218.

Rahaman S and Mukherjee PK. 2012. Comparative evaluation between rice straw mulching and herbicides for weed control in jute (*Corchorus olitorius* L.) under *tarai* agro–climatic region of West Bengal. *Journal of Crop and Weed* **8**(1): 184–186.

Singh R, Chaurasia S, Gupta AV and Soni P. 2014. Studies on effect of *Parthenium hysterophorus* plants extract on germination and growth in certain pulses. *Journal of Agricultural Science* **4**(4): 235–239.