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Research Article

Effect of Different Mulching Materials on Leaf Spot Disease of Groundnut

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Abstract

A study was conducted in summer season of 2020 and 2021 to evaluate the effect of different mulching materials on late leaf spot disease of groundnut caused by *Phaeoisariopsis personata* (Berk. & Curt.) v. Arx at Oilseed Research Program, Sarlahi, Nepal. The experiment was laid out in randomized complete block design (RCBD) with 7 treatments viz. rice husk, rice straw, black polythene sheet, *Lantana camara*, living mulch, sawdust and control in three replications with fertilizer dose 20:40:20 NPK kg per hectare. The disease was scored in 1-9 scale and severity and AUDPC was calculated. In 2020, *Lantana camara* mulched plot showed significantly the lowest disease severity and the lowest AUDPC value (66.67% and 1556) followed by rice husk (70.37% and 1556) and black plastic (70.37% and 1611) mulched plot. Similarly in 2021, *Lantana camara* mulched plot showed significantly lowest disease severity and the lowest AUDPC value (62.96% and 1500) followed by rice husk (66.67% and 1574) and black plastic (66.67% and 1574) mulched plot. Significantly the highest pod yield was obtained in rice husk mulched plot (2.35 t/ha in 2020 and 2.07 t/ha in 2021) followed by living mulch treated plot (2.13 t/ha in 2020 and 1.84 t/ha in 2021). The highest disease severity (81.4% same as rice straw and saw dust mulched plot) with highest AUDPC value (1981) was observed in plot with no mulch during 2020 where as in 2021, the highest disease severity (77.78 same as plot with no mulch) with highest AUDPC value (1889) was observed in rice straw mulched plot. This study shows that organic mulches like rice husk could be better option for reducing disease severity with better yield in groundnut.

Keywords: Groundnut; Late leaf spot; Mulch; Rice Husk; Yield

Introduction

Groundnut is one of the most important crop which was ranked fourth in oilseeds and 13th among food crop of the world (Nigam, 2014). It contains 26 to 28% protein and 48-50% oil content (Bhattarai *et al*., 2021). China together with India is the world's leading producer of groundnut, where China holds first position accounting for more than 40% followed by India with 15% share (Eagritrader, 2014). In Nepal groundnut is grown in 3342 ha of land with 4999 metric ton with productivity of 1.49 mt/ha (MOALD, 2020). The average low productivity of groundnut is result of many responsible factors of which disease are also major factors (Chaudhary, 2008). Around 20% loss in pod yield was estimated at moderate level of leaf spot disease severity under Terai/plain condition (Chaudhary, 2002) while world wise yield loss ranges from 10 to 50% (McDonald et al., 1985).

Late leaf spot disease of groundnut caused by *Phaeoisariopsis personata* (Berk. And Curt.) v. Arx can be controlled by spraying Bavistin @ 0.05 % with Dithane M -45 @ 0.2% ar 2-3 weeks interval (Ghosh et al., 2000) but it is difficult for Nepalese farmers due to its high cost and health hazards. So, there is need of non-hazardous approach to disease management. Mulching could be one option since

it is effective measures for weed control, conserving soil moisture, maintaining the soil temperature, and reduce disease infection to enhance the crop productivity. Organic mulch suppresses annual weeds, offer additional benefits as provides organic matter when decomposed (Veselinovic, 1991). BIack polythene sheet helps to supress weed, pest and pathogen growth (Barche and Nair, 2014). Similarly, Sawdust has allelopathic potential (Abouziena and Radwan, 2015). The chemical composition of *L. camara* oil plays a role in the biological activity. The extracts, essential oil, leachates, residues and rhizosphere soil around *L. camara* suppressed the germination and growth of other plant species (Kato-Noguchi and Kurniadie, 2021). Hence an experiment to evaluate the efficacy of different mulching materials in ground nut yield and disease was conducted at ORP during 2020 and 2021.

Methodology

Collection of Mulching Materials

Rice husk and rice straw were collected locally from the field. Black polythene sheet of 9 micron was brought and L.*camara* was collected from Forest Research and Training Center, Sagarnath, Sarlahi. Living mulches were collected from farmer's field and saw dust was managed from furniture shop in Lalbandi, Sarlahi.

Experimental Setup

The field experiment was conducted during summer season (June to November) of the year 2020 and 2021 in the premises of Oilseed Research Programme (ORP), Nawalpur, Sarlahi located at 26.9627° N, 85.5612° E with an elevation of 106m above mean sea level. The experiment was carried out in an area of 300.9 square meter (17m x 17.7m). The experiment was set up in Randomized Complete Block Design (RCBD) with seven treatments (rice husk, rice straw, black polythene sheet, L. *camara*, living mulch, sawdust, and un-mulched control) replicated three times. Individual plot size is 10.5 square meter i.e. (5 x 2.1) square meter with 1 m distance between replications and 0.5 m between treatments. The description of treatments is shown in Table 1. Each plot was ploughed two times followed by hoeing, and levelling. The recommended fertilizer dose of 20:40:20 NPK kg per hectare was sprayed. Spacing of 30cm x15cm was followed and groundnut was sown at the depth of 5 cm. The intercultural operations including irrigation and weeding were performed at regular intervals.

Data Recording and Analysis

Disease scoring data were recorded during growth periods. The visual disease scoring was done on basis of 1-9 point scale for late leaf spot disease suggested by Subrahmanyam *et al.* (1982) for late leaf spot disease scoring. The scoring was done four times at 10 days interval starting from 75 DAS of the trial. Disease severity and area under disease progress curve value was calculated using disease scoring data. Harvesting was done manually when the pods were fully matured indicated by browning of pod. After the harvest, yield data was recorded. The recorded data were compiled and analyzed using statistical software Genstat 18th Edition.

Table 1: Description of the treatments.

Treatments	Treatment combinations
T_1	Mulching with rice husk
T_2	Mulching with rice straw
T_3	Mulching with black polythene sheet (9 micron)
T_4	Mulching with *Lantana camara* stubble
T_5	Mulching with living mulch
T_6	Mulching with saw dust
T_7	Plot with no mulch

Results and Discussions

Effect of Mulching on Pod Yield

Mulching with rice husk (29.3 pods per plant with 2.35 tons pod per hectare in 2020 and 29.0 pods per plant with 2.07 tons pod per hectare in 2021) and living mulch (28.3 pods per plant with 2.13 tons pod per hectare in 2020 and 28.3 pods per plant with 1.84 tons pod per hectare in 2021) showed a significantly high pod yield during both years observation, Table 2. Significantly lowest yield (24.7 pods per plant with 0.90 tons pod per hectare in 2020 and 23.7 pods per plant with 0.87 tons pod per hectare in 2021) was observed in plot with no mulching. The yield obtained in polythene sheet was significantly lower (22.7 pods per plant with 0.98 tons pod per hectare in 2020 and 23.0 pods per plant with 0.96 tons pod per hectare in 2021) in comparison to other mulching treatments. Our result is similar to that performed by Ekwu *et al*. (2017) where rice hull mulched plots were found giving highest and black plastic mulch with lowest yield of cucumber. According to Tipu *et al*. (2014), highest number of fruits were recorded in rice husk and lowest in control. Moreover, Walsh *et al*. (1996) concluded that organic mulch and living mulch proved more effective in maintaining favourable soil temperature than other mulches. Rice husk was more effective compared with the plastic and no mulch types in increasing the yield of tomato (Nkansah *et al*., 2003). Rice husk contains 33% cellulose and 7% lignin (Jackson, 1977) where cellulose makes the plant stiff and strong and lignin provides structural support and enables long distance water transportation (Duchesne et al., 1989). Similarly, rice husk contains 20% silica (Mansaray & Ghaly, 1998) which increases the ability of plants to resist metal toxicities (Ma, 2004). According to Badar and Qureshi, 2014, rice husk mulch after being composted, improved total carbohydrate and protein contents that may increase the soil fertility by improving its organic content.

Table 2: Pod yield of groundnut under different mulching effects during 2020 and 2021

SN	Treatments	Pod yield (Pods/plant)		Pod Yield (tons/ha)	
		2020	2021	2020	2021
1	Mulching with rice husk	29.3	29.0	2.35	2.07
2	Mulching with rice straw	27.0	26.7	1.62	1.62
3	Mulching with black polythene sheet (9 micron)	22.7	23.0	0.98	0.96
4	Mulching with *Lantana camara* stubble	28.3	27.0	1.65	1.37
5	Mulching with living mulch	28.3	28.3	2.13	1.84
6	Mulching with saw dust	27.0	26.0	1.46	1.62
7	Plot with no mulch	24.7	23.7	0.90	0.83
	Grand Mean	26.8	26.2	1.59	1.47
	Min	22.7	23.0	0.90	0.83
	Max	29.3	29.0	2.35	2.07
	P-value	0.003	0.032	<.001	<.001
	LSD 0.05	2.80	3.7	0.23	0.4745
	CV, %	5.9	7.9	8.1	17.2

Table 3: Disease severity of late leaf spot and area under disease progress curve value under different mulching practice in groundnut during 2020 and 2021.

SN	Treatments	Disease severity percentage (%)		AUDPC value	
		2020	2021	2020	2021
1	Mulching with rice husk	70.37	66.67	1556	1574
2	Mulching with rice straw	81.48	77.78	1907	1889
3	Mulching with black polythene sheet (9 micron)	70.37	66.67	1611	1574
4	Mulching with *Lantana camara* stubble	66.67	62.96	1556	1500
5	Mulching with living mulch	74.07	74.07	1704	1685
6	Mulching with saw dust	81.48	74.07	1852	1778
7	Plot with no mulch	81.48	77.78	1981	1870
	Grand Mean	75.13	71.43	1738	1696
	Min	66.67	62.96	1556	1500
	Max	81.48	77.78	1981	1889
	P-value	0.051	0.004	0.004	<.001
	LSD 0.05	11.28	0.6724	217.50	106.8
	CV, %	8.4	5.9	7.0	3.5

Effect of Mulching on Disease Development

The mulching with *L. camara* significantly reduced late leaf spot disease severity during 2021 whereas significantly the lowest area under disease progress curve (AUDPC) value was observed in *L. camara* mulched plot in both years (66.67% disease severity with AUDPC value 1556 in 2020 and 62.96% disease severity with AUDPC value 1500 in 2021) followed by rice husk mulching (70.37% disease severity with AUDPC value 1556 in 2020 and 66.67% disease severity with AUDPC value 1574 in 2021) and black polythene sheet mulching (70.37% disease severity with AUDPC value 1611 in 2020 and 66.67% disease severity with AUDPC value 1574 in 2021), Table 3. The highest disease severity and AUDPC value was observed in the plot without mulching (81.48% disease severity with AUDPC value 1981 in 2020 and 77.78% disease severity with AUDPC value 1870 in 2021) or with rice straw mulching (81.48% disease severity with AUDPC value 1907 in 2020 and 77.78% disease severity with AUDPC value 1889 in 2021). The exudates, leachates from fruits and methanol extracted from leaves of L. *camara* inhibit different weed species (Mishra, 2015). Rice husk provides silica to soil and enhances resistance to foliar fungal pathogens (Ratnayake et al., 2018). Root application of soluble Si (in the form of $K_2 SiO_3$) reduces the severity of major foliar fungal diseases (Ratnayake et al., 2014). The reduction of disease severity could partly be attributed to Si-enhanced chemical defence responses including elevated activity of enzymes; peroxidase, polyphenol oxidase and pathogenesis-related proteins; chitinase and β-1, 3-

glucanase in leaf tissues (Ratnayake et al., 2016). resistance to mildew fungi is provided by silica through papillae formation and deposition of callose in the epidermal cell walls (Bélanger et al., 2003). Hence, rice husk can be suggested as an eco-friendly low-cost alternative to fungicides with several added beneficial effects (Ratnayake et al., 2018).

Conclusions

Mulching with rice husk stood out to be more significant among all other treatments in context of higher yields and lower disease infection. This could be due to presence of cellulose, lignin and silica that help in enhancing growth of plants and supress fungal growth. Thus, this paper could recommend to use rice husk as mulching materials. *L. camara* on the other hand, may provide advantage to the crop by suppressing the weeds and pathogens with its allelopathic effect. The exudates, leachates from fruits and methanol extracted from leaves of *L. camara* inhibit different weed and pathogen.

Authors' Contribution

All authors contributed equally in all stages of research work, data analysis and manuscript preparation. Final form of manuscript was approved by all authors.

Conflict of Interest

The authors declare that there is no conflict of interest with present publication.

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