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EFFECT OF SULPHUR ON INCIDENCE OF LINSEED POWDERY MILDEW, ITS IMPACT ON OIL AND OIL PROFILE

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Abstract: *To find out the effect of sulphur on incidence of linseed powdery mildew, its impact on oil and oil profile study was carried out during rabi season of 2013-14 at Linseed Research Farm, College of Agriculture, Nagpur, Maharashtra (India). Elemental and Sulphur (WP) was applied through soil and foliar application respectively. Results revealed that, foliar application of Sulphur 80 WP (0.3%) on 45 and 60 days after sowing (DAS) reduced the disease severity by 32.04% followed by 0.4% foliar application on same DAS which recorded significant superiority over rest of the treatments along with seed yield and oil content of linseed. Analysis of the fatty acid profile revealed that the linolenic acid, one of the major fatty acids, markedly influenced by Sulphur. Maximum linolenic acid 57.21% was noticed in 45 and 60 DAS against 50.91% in no application of Sulphur.*

Keywords: *Linseed, powdery mildew, fatty acid profile.*

Introduction: Linseed (*Linum usitatissimum* L.) is an important oilseed crop grown for both seed as well fibre. In South East Asia comprising, Turkistan, Afghanistan and India, it is mainly grown for oil purposes. Practically every part of linseed plant is commercially utilized either direct or after value addition. It is basically an industrial crop and about 80 per cent of oil is utilized by paints, varnishes, coating oil, linoleum, pad and printing inks, leather and soap industries. Linseed is highly nutritious and protects from several diseases. It is source complete protein comprising all eight essential amino-acids, high order linolenic acid (Omega-3 fatty acid) carbohydrates, vitamins and minerals. Recent medical researchers have found linseed as best herbal source of Omega-3 fatty acid Omega-6 fatty acids which have a lot of improving effect on human metabolism. Its stem provides good quality fibre which is lustrous and can be blended with wool, cotton silk, rayon and polyester well.

India is an important linseed producer which contributes about 11.82% to world acerage producing about 7% of world production. the major linseed growing area lies in MP, Chhattisgarh, Uttar Pradesh, Maharashtra, Bihar, Orissa, Jharkhand, Karnataka and Assam which together account for more than 95% of the total area. in India linseed predominantly grown on marginal and rain fed soils (63%) and *utera* (25%). The prime reason of lower productivity of crop is that major linseed producing area under cultivation lies under, sub marginal, un irrigated input starved and poor management condition in states referred to above. However, the remarkable increase in productivity of Rajasthan (1066 kg ha^{-1}), Bihar (865 kg ha^{-1}) and Nagaland (807 kg ha^{-1}) is almost surpassing the productivity of Asia (524 kg ha^{-1})[1]. Among the various diseases, powdery mildew, *Oidium lini* Skoric has been identified as one of the serious problem particularly in late sown crops normally in Vidarbha. The disease appears after mid of January at the time of capsule formation or seed setting; the powdery growth was observed on entire plant. The capsules were also covered with powdery mass therefore, the investigation was undertaken to study the efficacy of fungicides against the disease.

Materials and Methods

Field trial was carried out at Linseed Research Farm, College of Agriculture, Nagpur, Maharashtra, India using Randomized Block

Design with eight treatments with three replications during *Rabi* 2013-14. Linseed (variety-T-397) was sown on 10th December, 2013 with 30 cm apart. The soil application of gypsum @30 kg/ha as sulphur (S) was given at the time of sowing and the sprays of sulphur fungicides were applied at initiation of disease (on 8th February, 2014) and there after 45 and 60 days after sowing was given. No soil application and no spray of wettable sulphur act as sulphur. The disease intensity was evaluated by using 0-5 scale[2] and data was statistically analyzed[3]. The incremental cost benefit ratio (ICBR) was calculated by taking the total yield per ha. The gain in yield as compared to the untreated check to the fungicidal treatments was calculated by taking seed yield *vis-a-vis* amount spent (according o the prevailing market rates of the chemical, labours and selling price of linseed). The analysis for oil content and its oil profile was carried out at Project Coordinating Unit (Linseed), Kanpur.

Results and Discussion

Among several methods for management of Linseed powdery mildew, use of fungicides is important especially in the absence of resistant varieties. The application of fungicides reduces the incoming inoculums and its spared on the surface of the host plant .in absence of foliar sprays, the inoculums would have infected most of the foliage and such infected plants yielded less due to damage of photosynthetic area and pathogens ability to reduce the photosynthetic rate due to its biotrophic nature of infection.

In present studies, application of 0.3 % and 0.4 % as foliar spray of wettable sulphur at 45 and 60 DAS was found most effective in reducing the disease severity and intensity *i.e.* 29.00 and 34.67 PDI, respectively. Both the treatments recorded significant superiority and parity over rest of the treatments including check. The maximum yield and highest cost benefit ratio was realised with foliar spray of wettable sulphur, 0.3% and 0.4% with significant superiority over the rest. The present investigation is also in conformity with earlier workers[4,5] who reported wettable sulphur 0.3% given high cost benefit ratio in okra and maximum reduction of disease incidence, increased yield and maximum cost benefit ratio with wettable sulphur (0.25%) in black gram, respectively. The maximum oil content was noticed with soil application @ 30 kg sulphur /ha through gypsum at the time of sowing+ one foliar spray of sulphur (0.3%) followed by soil application of gypsum + one foliar spray of sulphur (0.3%) at 45 DAS + one spray of sulphur (0.3%) at disease initiation recorded more percentage of oil over rest of the treatments including check. The fatty acid profile study revealed that the linolenic acid (one of the major fatty acids), markedly influenced with sulphur application. Maximum linolenic acid (57.0%) *i.e.* Omega-3 with foliar spray of sulphur 0.03% and 0.4% at 45 and 60 DAS whereas it was minimum with soil application + one spray of sulphur 0.3% at 45 DAS. Sulphur increases the percentage of oil content of seed and promote formation of saturated fatty acids and metabolism of carbohydrates[6]. Sulphur response was better on sulphur deficient soils. It improves oil content and oil synthesis[7]. These reports support the results of the present findings.

It is evident from the present studies that wettable sulphur applied twice at 45 and 60 DAS was highly effective for management of powdery mildew, yield and obtaining higher monetary returns as well as improvement in oil content and its quality.

Table 1. Effect of sulphur application on powdery mildew intensity, yield, oil and its quality in linseed

S.N.	Treatments	Powdery mildew (PDI)	Seed yield (kg/ha)	Oil content (%)	B:C ratio	Oil quality (fatty acid profile)				
						Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid
1	Soil application @ 30 S/ha through gypsum at the time of sowing	46.0 (51.07)	433.06	35.48	1.69	6.80	4.26	23.22	14.49	51.24
2	Soil application of S (Tr. 1) + One foliar spray of Sulphur @ 0.3% (Sulfex 80% WP) at the 45 DAS	41.3 (43.06)	429.17	36.43	1.61	6.79	4.38	23.34	19.00	48.49
3	Foliar spray of Sulphur on 45 DAS@ 0.3% (Sulfex 80 WP) Foliar spray of Sulphur on 60 DAS@ 0.3% (Sulfex 80% WP)	32.04 (28.7)	607.78	35.44	2.32	11.34	3.25	15.22	12.98	57.21
4	Foliar application of Sulphur on 45 DAS @ 0.4% (Sulfex 80% WP) Foliar spray of Sulphur on 60 DAS@ 0.4% (Sulfex 80% WP)	36.0 (34.5)	577.22	35.49	2.17	5.91	4.42	20.06	12.54	57.08

5	Soil application of S (Tr. 1) + One spray on 45 DAS @ 0.3% (Sulfex 80% W.P.) One spray at initiation of disease @ 0.3% (Sulfex 80% WP)	38.07 (39.01)	569.72	36.00	2.15	7.68	1.60	29.73	14.46	48.54
6	Foliar application of Sulphur at 45 DAS @ 0.3% (Sulfex 80% WP) One spray at initiation of disease @ 0.3% (Sulfex 80% WP)	50.05 (59.05)	568.89	35.89	2.15	6.85	4.33	25.18	14.14	49.49
7	Control (No soil application and no spray)	52.8 (63.04)	255.56	35.15	1.69	6.81	4.68	24.05	13.55	50.91
	SE (m) ±	2.95	59.08							
	CD at 5%	9.19	182.06							

Figures in parenthesis indicates arcsine transformed values.

Conclusion

Based on above findings it was concluded that application of wettable sulphur at 45 and 60 DAS proved highly effective for management of powdery mildew resulting in higher yield and monetary returns as well as improvement in oil content and its quality**.**

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