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Weather factor and chemical management against late leaf spot (LLB) and rust diseases under rainfed groundnut conditions

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Abstract

Groundnut (*Arachis hypogaea* L.) is most growing under rainfed conditions, the important disease of late leaf spot and rust reduction of yield in rainfed condition. Experiments were conducted 2012, 2013 and 2014. The temperature for three years minimum temperature 23.57 °C temperature 37.54 °C combination of weather conditions during the growing season of groundnut foliar diseases of Late leaf spot and Rust diseases for favourable severe conditions. Among the different chemicals tested for three years the combination of Carbendazim + Mancozeb (SAAF)@1.25Kg/ha recorded the least diseases incidence of Late leaf spot (22.36%) and rust (17.58%) with accounting of diseases reduction for late leaf spot (61.24%) and rust (70.03%) followed by carbendazim and chlorothalonil. The individual application copper hydroxide controlled the rust disease effectively when compared to other treatments also increased yield 1003.67kg/ha. The Carbendazim + Mancozeb (SAAF) @ 1.25kg/ha broad spectrum fungicide for reduced the spraying schedule and no of chemicals used and also protective and curative action with contact and systemic in nature groundnut cultivations under rain fed condition.

Keywords: Temperature, late leaf spot leaf spot, rust, chemical, management

Introduction

Groundnut is called as the 'King' of oilseeds. It is one of the most important food and cash crops of our country. While being a valuable source of all the nutrients, it is a low priced commodity. Groundnut is also called as wonder nut and poor men's cashew nut. In tamilnadu, cultivated around 6.19 lakh hectares with the production of 10.98 lakh tonnes. In this 70% under rainfed cultivation and remaining 30% under irrigated condition. Peanut rust (*Puccinia arachidis* Speg.) reduces the yield, under disease epiphytic, the pathogen causes up to 57% economical damage to the crop (Mondal and Badigannavar, 2015) [7] late leaf spot caused by *Phaeoisariopsis personata* are commonly present wherever groundnut is grown. leaf spots along with rust can causes yield losses up to 50-70% (Grichar *et al.*, 1998 and Gopal *et al.*, 2006) [4, 3] As the area under groundnut is predominant in kharif (rainy) season (81%), the foliar diseases like late leaf spot and rust may cause yield losses up to 50% in the semi-arid tropics. (Bharath chandranath *et al.* 2013) [4]. Azadirachta indica leaf extracts control leaf spot (Hasan *et al.*, 2016) [5] Carbendazim 12% + mancozeb 63% WP (0.15%) only control for Minimum per cent disease index of early (30.76%) and late (59.38%) leaf spot. (Gadhiya Kavitaaben Kanubhai, *et al.*, 2018) [2]. Based on the views the rainfed condition influence the weather factor and application chemical fungicides particular periods to overcome the late leaf spot and rust disease The tridemorph chemicals specific to rust disease control in this study alternate to tridemorph chemicals needed to rust management.

Materials and Methods

The experimental trial consisting of 10 treatments was laidout at Dryland Agricultural Research Station, Chettinad during 2012-2014 with the test crop groundnut (TMV 7). Randomized Block Design was adopted with three replications. The plot size for each treatment was 20m². All normal agronomic practices were followed and the yield parameters were recorded and analyzed statistically. The disease incidence was observed at 15 days interval using the disease scoring chart 1-9 scale and also recorded the yield kg/ha.

The minimum temperature and maximum temperature, leaf wetness, Relative humidity was daily observed during the growing season of groundnut cultivation fifteen days mean of weather parameters (independent variables) were. The prediction equation was worked out through multiple regression analysis using SPSS computer software. Coefficient of determination (R²) were also calculated and tested for significance at 1% level of probability. The germination and Disease incidence observed at regular intervals. In addition, growth parameters viz., plant height, number of branches. Number of pods/plant, and seed yield kg/ha, were also recorded. Percent disease index (PDI) was calculated on 15 days interval using the following formula:

$$PDI = \frac{\text{Sum of all ratings}}{\text{Total No. of observed leaves} \times \text{maximum disease grade}} \times 100$$

For the estimation of disease incidence, leaves were seen from each plot in each replication and the disease was recorded using modified 9 point scale (Subrahmanyam *et al.*, 1995) the spraying chemicals for individual fungicides and combination fungicides at 50th DAS and 65thDAS tested against late leaf spot and rust diseases.

Results and Discussion

Weather factor

Field trials were conducted in 2011-2014 at Dryland Agricultural Research Station, Chettinad, Tamilnadu, India. The temperature for three years minimum temperature 23.57 °C temperature 37.54 °C combination of weather conditions during the growing season of groundnut foliar diseases of Late leaf spot and Rust diseases for favourable severe conditions (fig.1.).

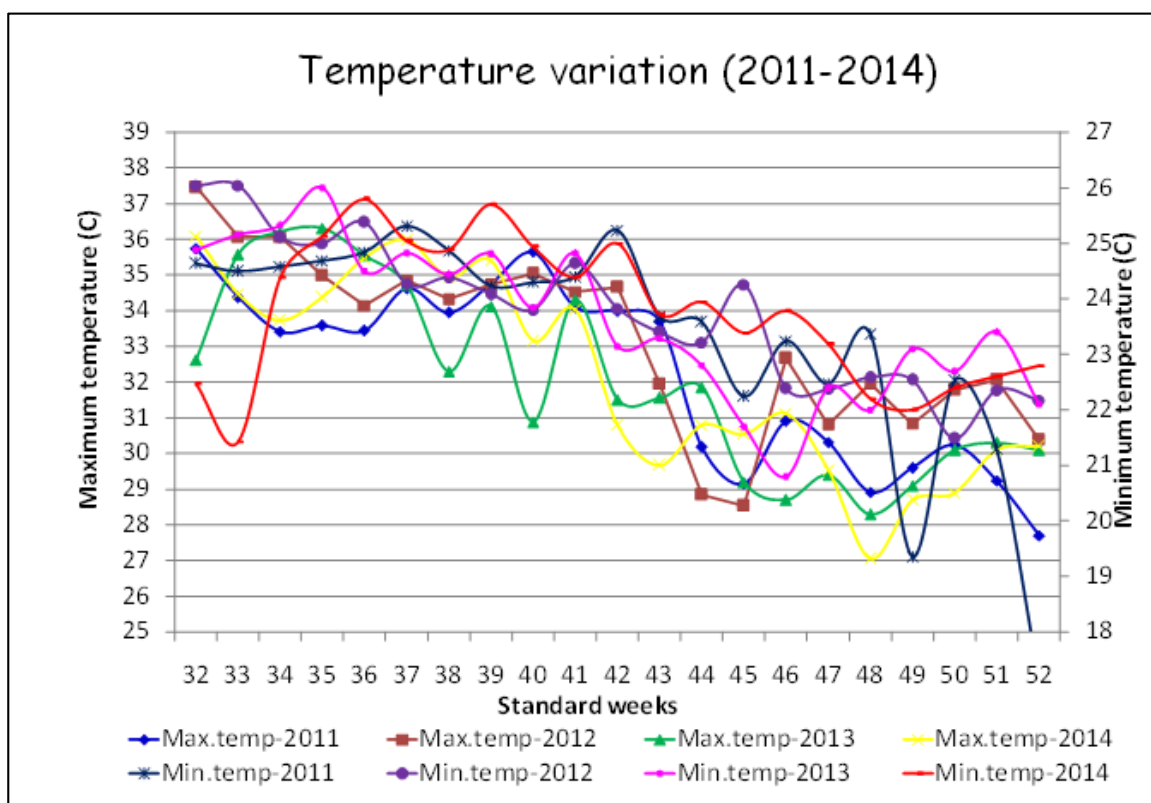


Fig 1: Temperature variation in late leaf spot and rust severity at DARS, chettinad.

Correlation weather factor

Herein analysis was carried out to identify whether there is significant relationship between weather factors and leaf spot and rust

Null Hypothesis – There is no significant relationship between the weather factors and leaf spot and leaf rust.

Table 1: Correlation: Weather Factors and Leaf Spot and Leaf Rust

Correlations			
		Leaf Spot	Leaf Rust
Maximum Temp	Pearson Correlation	.447	.534
	Sig. (2-tailed)	.450	.354
	N	5	5
Minimum Temp	Pearson Correlation	.720	1.000**
	Sig. (2-tailed)	.170	.000
	N	5	5
Rainfall	Pearson Correlation	-.571	-.023
	Sig. (2-tailed)	.315	.971
	N	5	5
Leaf wetness	Pearson Correlation	-.465	-.262
	Sig. (2-tailed)	.430	.670
	N	5	5

wind speed	Pearson Correlation	-.454	-.878
	Sig. (2-tailed)	.442	.050
	N	5	5
RH	Pearson Correlation	-.706	-.296
	Sig. (2-tailed)	.182	.628
	N	5	5
Leaf Spot	Pearson Correlation	1	.720
	Sig. (2-tailed)		.170
	N	5	5
Leaf Rust	Pearson Correlation	.720	1
	Sig. (2-tailed)	.170	
	N	5	5
**. Correlation is significant at the 0.01 level (2-tailed).			

From the Correlation table the estimated significance value is 0.000 for minimum temperature and leaf rust, meaning the null hypothesis is rejected. Therefore there is significant

relationship. Further the R value calculated to be 1, meaning there is 100.00% strong positive relationship between minimum temperature and leaf rust.

Table 1a: Average three years weather factors

Weather Factors					
Days	max temp	Mini temp	Leaf wetness	wind speed	RH
45	34.94	24.89	4.51	4.94	74.4
60	33.17	24.94	3.29	4.69	76.05
75	30.79	25.00	3.91	1.84	70.18
90	30.80	23.94	3.71	7.93	70
105	31.13	23.79	4.46	7.34	80.18
Descriptive Statistics					
Mean	32.16	24.51	3.97	5.34	74.16
Standard Error	0.822	0.265	0.230	1.084	1.910
Standard Deviation	1.839	0.594	0.516	2.425	4.272
Sample Variance	3.38	0.353	0.266	5.885	18.254
Kurtosis	-0.528	-3.095	-1.606	-0.354	-0.963
Skewness	1.077	-0.625	-0.231	-0.537	0.478
Range	4.15	1.21	1.22	6.09	10.18
Minimum	30.79	23.79	3.29	1.84	70.00
Maximum	34.94	25.00	4.51	7.93	80.18
Sum	160.83	122.56	19.88	26.74	370.81
Count	5	5	5	5	5

Weather Factor – Maximum Temperature

From the descriptive statistics using weather factor in three years, it can be interpreted that the maximum temperature of weather factor for average 3 years is on an average 32.16 °C with an standard deviation 1.839 °C. The Kurtosis value was estimated to be -0.528 [Std. Value -1 to +1] therefore the dataset has neither flatness nor peaks over the past average 3 year's maximum temperature. The skewness value is calculated to be 1.077 °C [Std. Value: (-0.5 to +0.5)-Symmetrical, (-1 to -0.5 or 0.5 to 1)-Moderately Skewed (>-1 or <1)- Highly skewed] meaning the dataset is highly positively skewed (Table 1.). Further, it was found that the maximum temperature from weather factor was lowest [30.79 °C] during average 3 years of 75 days and highest [34.94 °C] during average 3 years of 45 days.

Minimum Temperature

Three year minimum temperature, it can be interpreted that the minimum temperature of weather factor for average 3 years is on an average 24.51 °C with an standard deviation 0.59 °C. The Kurtosis value was estimated to be -3.09 [Std. Value -1 to +1] therefore the dataset has neither flatness nor peaks over

the past average 3 years maximum temperature. The skewness value is calculated to be -0.625 °C [Std. Value: (-0.5 to +0.5)-Symmetrical, (-1 to -0.5 or 0.5 to 1)-Moderately Skewed (>-1 or <1)- Highly skewed] meaning the dataset is highly positively skewed. Further, it was found that the Minimum temperature from weather factor was lowest [23.79 °C] during average 3 years of 90 days and highest [24.94 °C] during average 3 years of 60 days.

Relative Humidity

Three year Relative humidity is can be interpreted that the relative humidity for average 3 three year 74.16 per cent with an standard deviation 4.22%. The Kurtosis value was estimated to be -0.963 [Std. Value -1 to +1] therefore the dataset has neither flatness nor peaks over the past average 3 years RH. The skewness value is calculated to be 0.478% [Std. Value: (-0.5 to +0.5)- Symmetrical, (-1 to -0.5 or 0.5 to 1)-Moderately Skewed (>-1 or <1)- Highly skewed] meaning the dataset is highly positively skewed. Further, it was found that the RH from weather factor was lowest [70.0%] during average 3 years of 90 days and highest [80.18%] during average 3 years of 105 days.

Table 2: Fungicides application against late leaf spot diseases conducted field experiment in the year of 2011-2012

S. No	Treatments	Dose ml/ha	Pre Treatment Disease incidence* (%)	I st spraying* at 50 DAS		II nd spraying* at 65DAS		Mean Disease incidence (%)
			45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	
T1	Chlorothalonil 75% WP	1kg	33.26	30.24	28.16	25.19	22.35	27.84
T2	Carbendazim 50WP	500g	34.15	33.18	28.36	25.39	22.58	28.73
T3	Mancozeb	1kg	35.62	34.16	31.65	28.67	28.67	31.75
T4	Tridemorph 75 EC	500ml	34.18	34.28	33.28	30.19	29.19	32.22
T5	Copper hydroxide 77% WP	400gm	33.18	30.35	29.68	26.38	25.13	28.94
T6	Carbendazim+ Mancozeb	1.25kg	35.61	28.17	23.68	15.18	13.27	23.18
T7	Iprodione+ Carbendazim	1kg	34.65	31.28	30.14	27.39	26.17	29.93
T8	Cymoxanil + mancozeb	1kg	35.14	31.68	29.29	27.69	27.15	30.19
T9	Carbendazim& Tridemorph	(1:1)	36.24	31.64	30.67	28.88	27.19	30.92
T10	Mancozeb & Chlorothalonil	(1:1)	37.89	32.68	28.69	25.39	22.18	29.37
T11	Carbendazim & Copper hydroxide	(1:1)	35.18	32.65	30.24	26.39	22.16	29.32
T12	Control		33.15	49.68	58.67	70.18	89.15	60.17
CD (P=0.05)								1.75

Table 2a: Fungicides application against Rust diseases conducted field experiment in the year of 2011- 2012

S. No	Treatments	Dose ml/ha	Pre Treatment Disease incidence* (%)	I st spraying* at 50DAS			II nd spraying* at 65 DAS	Mean Disease incidence (%)
			45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	
T1	Chlorothalonil 75% WP	1kg	24.65	24.15	23.68	22.19	22.19	23.37
T2	Carbendazim 50WP	500g	26.18	25.61	23.68	21.98	23.35	24.16
T3	Mancozeb	1kg	24.36	22.18	20.68	18.64	17.98	20.77
T4	Tridemorph 75 EC	500ml	25.14	21.89	18.92	16.37	15.75	19.61
T5	Copper hydroxide 77% WP	400gm	23.27	22.15	22.56	23.16	25.18	23.26
T6	Carbendazim+ Mancozeb	1.25kg	26.15	20.19	16.97	14.58	13.05	18.19
T7	Iprodione+ Carbendazim	1kg	24.35	23.64	22.38	20.19	20.19	22.15
T8	Cymoxanil + mancozeb	1kg	26.18	24.18	24.05	23.67	23.67	24.35
T9	Carbendazim& Tridemorph	(1:1)	24.15	21.38	19.68	17.35	15.19	19.55
T10	Mancozeb & Chlorothalonil	(1:1)	25.36	21.97	20.17	18.35	17.98	20.77
T11	Carbendazim & Copper hydroxide	(1:1)	22.17	22.56	20.67	20.67	21.69	21.55
T12	Control		23.18	48.95	67.95	79.62	86.98	61.34
CD (P=0.05)								1.5

Chemicals against late leaf spot

The experiment result revealed that, late leaf spot infection ranged from 33.18 to 37.89 per cent before imposing treatments (Table 2). The three applications of fungicides in 15 days interval the Mean data revealed that late leaf spot damage on leaves ranged from 23.18 to 60.17 Decrease disease incidences. Among the treatment the combination chemicals Carbendazim + mancozeb (SAAF) @ 1.25kg/ha which recorded 23.18% Chlorothalonil @ 1Kg/ha recorded (27.84%), Carbendazim @ 500gm/ha recorded 28.73% contributed significant reduction to 61.47, 53.73 and 52.25 per cent reduction over control respectively similar observation (Gadhiya Kavtaben Kanubhai, *et al.*, 2018) [2]. recorded Minimum per cent disease index of early (30.76%) and late (59.38%) leaf spot recorded in foliar application of carbendazim 12% + mancozeb 63% WP (0.15%) only control for leaf spot.

Chemicals against Rust in rainfed groundnut

The experiment result revealed that, rust infection ranged from 22.17- to 26.18 per cent before imposing treatments (Table 2a). The three applications of fungicides in 15 days interval the Mean data revealed that rust damage on leaves ranged from 18.19 to 61.34 Decrease disease incidences. Among the treatment the combination chemicals Carbendazim + Mancozeb (SAAF) @ 1.25kg/ha which recorded 18.19% Carbendazim and tridemorph (1:1)(v/v) recorded (19.55%), Tridemorph @ 500gm/ha recorded 19.61%, mancozeb 20.77% and Mancozeb and Chlorothalonil

(1:1) 20.77% were on par and which contributed significant reduction to 70.34, 68.12, 68.03 and 66.13 per cent reduction over control respectively.

Three year pooled data analysis

The experiment result revealed that, the three year pooled data analysis the fungicides application two time spraying 50 DAS and 65DAS, observation of disease incidence in 15 days interval the Mean data revealed that late leaf spot damage on leaves ranged from 22.36 to 57.62 Decrease disease incidences (Table3). Among the treatment the combination chemicals Carbendazim + mancozeb (SAAF) @ 1.25kg/ha which recorded 22.36% Carbendazim @ 500gm/ha (26.90%) Chlorothalonil @ 1Kg/ha recorded (26.90%), recorded percent disease incidence comparing to control (57.62%).

The three year pooled Mean data revealed that rust damage on leaves ranged from 17.58-58.66 Decrease disease incidences (Table3). Among the treatment the combination chemicals Carbendazim + Mancozeb (SAAF) @ 1.25kg/ha which recorded 17.58% followed by mancozeb 21.61% Carbendazim 22.50 and Chlorothalonil 22.51% were on par each other. The unsprayed control severe diseases (58.66%) in control respectively premixture of Azoxystrobin 7.5% + Propiconazole 12.5% SE @ (65.62+109.38 g a.i. /ha and 75+125g a.i. /ha) significantly reduced both the diseases (8.75% & 8.70% for tikka and 9.16% & 9.20% for rust) and increased yield 20.75 and 21.25 qha-1 (Sunita Mahapatra, 2016) [10].

Among three year data the Carbendazim + Mancozeb (SAAF)@1.25kg/ha for Highest Diseases reduction for late leaf spot (61.24%) and rust (70.03%) followed by copper hydroxide (50.16% and 60.22%) carbendazim and Chlorothalonil for late leaf spot and, carbendazim and chlorothalonil for rust diseases (61.62 and 61.64per cent

control) and was onpar with each other, comparing to Control and other chemicals (Table 4.) The tebuconazole (0.1 per cent) was found to be the best fungicide to control tikka disease of ground nut and the second best fungicide was carbendazim (0.1 per cent) (Mushrif *et al.*, 2017) [8]

Table 3: Efficacy of chemicals against Late leaf spot and rust leaf spot of rainfed groundnut (Three years pooled data)

S. No	Treatments	Dose (ha)	Late leaf spot Disease incidence (%)				Rust Diseases Incidence (%)			
			2012	2013	2014	Mean diseases incidence (%)	2012	2013	2014	Mean Diseases incidence (%)
T1	Chlorothalonil 75% WP	1Kg	27.84	28.99	23.86	26.90	23.37	20.82	23.35	22.51
T2	Carbendazim 50WP	250gm	28.73	29.00	21.00	26.24	24.16	21.01	22.32	22.50
T3	Mancozeb	1kg	31.75	29.55	23.40	28.24	20.77	21.15	22.91	21.61
T4	Copper hydroxide 77% WP	400gm	28.94	29.34	27.97	28.75	23.26	20.43	26.29	23.33
T5	Carbendazim+ Mancozeb (SAAF)	1.25kg	23.18	24.64	19.25	22.36	18.19	16.26	18.30	17.58
T6	Iprodione+ Carbendazim	1kg	29.93	32.53	34.16	32.21	22.15	23.08	31.32	25.52
T7	Cymoxanil + mancozeb	1kg	30.19	32.26	31.88	31.44	24.35	23.75	33.23	27.11
T8	Mancozeb & Chlorothalonil	1:1 (v/v)	29.37	31.44	31.24	30.68	20.77	19.94	31.69	24.13
T9	Carbendazim & Copper hydroxide	1:1 (v/v)	29.32	30.73	33.04	31.03	21.55	22.56	34.45	26.19
T10	Control		60.17	60.19	52.72	57.69	61.34	61.45	53.18	58.66
CD (0.05%)						1.83				0.95
SEd						0.87				0.45
CV%						3.38				1.88

Table 4: Effect of chemicals against groundnut Late leaf spot and Rust reduction

S. No	Treatments	Dose (ha)	Pooled data analysis (2012-2014)			
			Late leaf spot Disease incidence (%)		Rust Disease incidence (%)	
			Mean diseases incidence (%)	Percent reduction over control	Mean Diseases incidence (%)	Percent reduction over control
T1	Chlorothalonil 75% WP	1Kg	26.90	53.37	22.51	61.62
T2	Carbendazim 50WP	250gm	26.24	54.51	22.50	61.64
T3	Mancozeb	1kg	28.24	51.04	21.61	63.16
T4	Copper hydroxide 77% WP	400gm	28.75	50.16	23.33	60.22
T5	Carbendazim+ Mancozeb (SAAF)	1.25kg	22.36	61.24	17.58	70.03
T6	Iprodione+ Carbendazim	1kg	32.21	44.16	25.52	56.49
T7	Cymoxanil + mancozeb	1kg	31.44	45.50	27.11	53.78
T8	Mancozeb & Chlorothalonil	1:1 (v/v)	30.68	46.81	24.13	58.86
T9	Carbendazim & Copper hydroxide	1:1 (v/v)	31.03	46.21	26.19	55.35
T10	Control		57.69	-	58.66	-

Table 5: Yield and cost benefit ratio for chemicals against Late leaf spot and rust leaf spot and yield and CB ratio of rainfed groundnut (Three years pooled data)

S. No	Treatments	Dose (ha)	2012	2013	2014	Mean yield (Kg/ha)	CB Ratio
T1	Chlorothalonil 75% WP	1Kg	920	925	912	919.00	1: 1.72
T2	Carbendazim 50WP	250gm	860	863	890	871.00	1: 1.65
T3	Mancozeb	1kg	845	840	853	846.00	1: 1.35
T4	Copper hydroxide 77% WP	400gm	850	854	864	856.00	1: 1.50
T5	Carbendazim+ Mancozeb (SAAF)	1.25kg	995	988	1028	1003.67	1: 2.0
T6	Iprodione+ Carbendazim	1kg	825	812	824	820.33	1: 1
T7	Cymoxanil + mancozeb	1kg	845	850	875	856.67	1: 1.58
T8	Mancozeb & Chlorothalonil	1:1 (v/v)	865	864	863	864.00	1: 1.60
T9	Carbendazim & Copper hydroxide	1:1 (v/v)	845	790	829	821.33	1: 1.3
T10	Control		689	720	780	729.67	
CD (0.05%)						25.80	
SEd						12.28	
CV%						2.28	

Table 5a: Effect of fungicides applications groundnut Plant parameter in field conditions.

S. No	Treatments	Dose (ha)	Plant ht (cm)	Branches (No.)	No of pods/plant	5 plant wet wt (gm)	5 plant dry wt (gm)
T1	Chlorothalonil 75% WP	1Kg	43.47	9.06	37.08	195.70	154.5
T2	Carbendazim 50WP	250gm	46.45	9.27	41.20	318.30	283.25
T3	Mancozeb	1kg	44.91	8.45	36.87	298.70	270.89
T4	Copper hydroxide 77% WP	400gm	37.29	7.00	23.90	195.70	178.705
T5	Carbendazim+ Mancozeb (SAAF)	1.25kg	47.17	8.03	41.41	319.27	292.52
T6	Iprodione+ Carbendazim	1kg	46.14	8.45	39.96	314.15	289.43
T7	Cymoxanil + mancozeb	1kg	44.08	7.00	37.90	267.80	231.75

T8	Mancozeb & Chlorothalonil	1:1 (v/v)	39.14	6.59	26.78	226.60	195.7
T9	Carbendazim & Copper hydroxide	1:1 (v/v)	46.97	7.83	29.46	185.40	164.8
T10	Control		22.15	6.39	19.88	149.35	92.7
	CD (0.05%)		1.02	0.7	1.19	16.41	16.68

The Carbendazim + Mancozeb (SAAF)@1.25Kg/ha combination at 50 and 65 days after spraying decreased the foliar diseases of late leaf spot (61.24%) and rust (70.03%) incidence and also recorded increased the yield of 1003 kg/ha. The cost benefit analysis was also more in Carbendazim + Mancozeb (SAAF)@1.25Kg/ha combinations as 1:2. Increased the plant height (47.17cm), branches (8.03Nos), no.of pods per plant (41.41Nos) and foliage yield (319 and 292.52gm/5 plant). Due to the application of the Carbendazim + Mancozeb (SAAF) @ are broad spectrum fungicides with protective and curative action with contact and systemic in nature Similarly, Johnson *et al.* (1998) ^[6] achieved good control of leaf spot of groundnut with an increased in yield by 20% in foliar application of carbendazim + mancozeb.

Conclusion

Concluded that among three year the weather factor maximum and minimum temperature favour at 60 days for increasing the late leaf spot and also these temperature and Relative humidity favour of rust incidence at 90th days after sowing at that spraying of Carbendazim + Mancozeb (SAAF) at 50 and 65 days two spraying enough for groundnut cultivation under rain fed conditions, these chemicals reduced the spraying time and number of chemicals used against late leaf spot and rust disease control, these for alternating to tridemorph chemical fungicides.

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