Demonstration on effect of new molecules for management of tikka leaf spot and rust diseases in groundnut

Abstract

Tikka leaf spot and rust diseases are major constraints in groundnut at Nellore district of Andhra Pradesh. We conducted front line demonstration for demonstration of new molecules for management of foliar diseases in groundnut and the experiment was carried out at different farmer's field. The farmers practicing variety TAG24 is highly susceptible to tikka leaf spot and soil borne diseases. The trial was conducted during rabi season for two years. During rabi, 2022-23, the percent disease incidence of tikka leaf spot recorded 38.46% in demo plot where as in farmer practice 74.62% recorded. During rabi 2023-24, recorded 38.8% and 65.4% tikka leaf spot disease in demo plot and farmer practice respectively. The average yield was increased 5% more in demo plot over farmer practicing plot. The average of two years, rust diseases recorded 5% in demo plot and 16% in farmer practice. In both treatments the incidence of tikka leaf spot was high due to farmers practicing variety is highly susceptible to foliar diseases and farmers are used higher seed rate i.e. 200kg/acre. Based on results we concluded that the combination fungicides i.e. tebuconozole 50% +trifloxystrobin 25% WG and pyraclostrobin 5% +metiram 55% WG are best chemicals than single mode of action fungicides and time of application of fungicide is also important.

Key words:

Andhra Pradesh, Groundnut, foliar diseases, new molecules for management,

Introduction

Groundnut (*Arachis hypogaea* L.), is an important legume crop growing in both tropical and sub-tropical areas of the world. It is major oil seed crop its kernels contain about 48 per cent edible oil, 26 per cent protein, 20 per cent carbohydrates, 3 per cent fiber and also rich in calcium, thiamine and niacin. Due to the rich source of edible oil, this crop is called as "King of oil seed crops". Symbiotic association of groundnut crop with nitrogen-fixing bacteria, fixes the atmospheric nitrogen and enriches the soil with 80-160 kg N/ha per season (Bajaya *et al*., 2022). After extraction of oil from kernel, the groundnut cake used as cattle feed and also as manure (Sharma *et al*., 2020).

Globally groundnut crop was cultivating in 327 lakh ha with production of 539 lakh tonnes and productivity 1648 kg per ha. With annual all-season coverage of 54.2 lakh hectares, globally, India ranks first in Groundnut area and is the second largest producer in the world after china with 101 lakh tonnes with productivity of 1863 kg per hectare in 2021-22. The major groundnut growing states in India are Gujarat, Andhra Pradesh, Rajasthan, Tamil Nadu, Telangana, Odisha, Karnataka, and Maharashtra (Directorate of Economics and Statistics, 2020). In Andhra Pradesh, groundnut is cultivated in 8.23 lakh ha area with a production of 5.19 lakh tonnes, for the year 2021-22. (ANGRAU groundnut outlook report).

Groundnut production is decreasing gradually because of various biotic and abiotic stresses (Pamala *et al*., 2023). The crop is susceptible to various plant pathogens like fungi, viruses and

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nematodes are effects on yield, resulting in poor yields and quality of the produce. Among these pathogens, fungal diseases i.e. foliar diseases (early and late leaf spot, rust) and soil borne diseases (stem rot, collar rot and root rot) are most devastating and cause substantial yield losses. The virus diseases i.e. groundnut bud necrosis diseases and stem necrosis diseases emerged diseases and due to the wide host range these two virus diseases causes up to 60% yield losses. Both root knot nematode and pod nematode are the major problem in groundnut where the crop practicing as monocrop and cultivating in sandy soil (Joshi *et al*., 2020).

The early leaf spot disease caused by *Cercospora arachidicola* Hori generally occurs at 30DAS. Initially circular chlorotic spots develop on upper surface of leaf later turn to brown colour surrounded by yellow halo. Late leaf spot caused by *Phaeoisariopsis personata* (Berk & Curt.) starts to infect the crop around 60 DAS continuous up to harvest. On lower surface of the leaves irregular dark brown to black colour spots appears and infected leaves may drop off prematurely (Figure.1). Rust caused by ***Puccinia arachidis*** Speg. and symptoms appear on the all above ground parts of the plant except flowers. Initially chlorotic flecks develop on upper surface of the leaf and on corresponding lower surface, orange colored pustules appear which later turn to brown in colour (Nataraj *et al*., 2014). Due to its drastic reduction of photosynthetic tissues in plant foliar parts caused by foliar diseases, leads to about 70% yield loss recorded in susceptible cultivars (Kankam *et al*., 2022).

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Figure.1: The early leaf spot (left) and late leaf spot (Right) disease symptoms observed during data collection

Andhra Pradesh is one of the major groundnut producing state in India. Groundnut has been one of the highest yielding oilseeds in Andhra Pradesh and has exhibited positive trends in TFP (Total Factor productivity) over the past two decades, specifically highlighting the years 2009-2010, 2019-2020, and 2020-2021 (Rehman *et al*. 2023). In Nellore district of Andhra Pradesh, groundnut crop is cultivating mostly in sandy soils as solo crop in both season under irrigation condition. The TAG24 is major variety growing in Nellore district is highly susceptible to tikka leaf spot and soil borne diseases. The foliar diseases can be control by spraying of fungicides at recommended doses at right time but difficult to manage the soil borne diseases by following of single management practices.

For management of foliar diseases, scientist developed management practices by following different approaches. These approaches are chemical, biological, cultural management, and

breeding for resistant varieties (Kankam *et al*., 2022). In general, for disease management uses fungicides and very rarely farmers go for other alternatives such as cultural, physical, biological methods etc. it is difficult to manage the diseases through a single method. Integration of best disease management practices for peanut diseases would be an effective approach. Appropriate use of fungicides with bio-control agents could be a cost-effective and eco-friendly approach. Repeated application of fungicides, the pathogen developed resistance to fungicides (Jadon *et al*., 2017). In the present studies, we demonstrated new fungicide molecules for management of foliar diseases in groundnut.

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Materials and Methods

The experiment was conducted at farmer's fields at different locations and demonstrated effect of new molecules for foliar disease management with five replications of each one-acre land during Rabi season for two years from 2022-23 to 2023-24 (Figure.02). The cultivating variety is TAG 24 susceptible to foliar and soil borne diseases. The experiment was design as Front Line Demonstration (FLD) and treatments are

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TO1 (Demonstration):

- Spraying of hexaconazole @ 2ml/lit at 30 DAS,
- Spraying tebuconazole @ 1ml/lit at 40DAS,
- Spraying of tebuconozole 50% +trifloxystrobin 25% WG @1.3g/ l and
- Spraying of pyraclostrobin 5% +metiram 55% WG @ 2 g/l at 50 DAS and 60 DAS respectively in demonstrated plot.

TO2 (Farmer practice):

- Spraying of fungicides repeatedly on pesticide dealer recommendation based.

Figure.02: Fungicides which was mentioned in demo treatment given to farmer and trial was initiated.

The observations of percent disease incidence were recorded before and after application of treatments (Figure.3). The other data like pod yield, cost of cultivation, gross return, net returns and B:C ration was calculated.

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$$\text{Percent Diseases Incidence (PDI)} = \frac{\text{Total Number of infected Plants per sq. m}}{\text{Total number of plants per sq. m}} \times 100$$

Figure.03: The tikka leaf spot and rust disease incidence was recorded from demo and farmer practicing plots.

The PDI, yield data was recorded in one square meter area of crop and total 5 square meter from each replication/field both from demonstration plot and farmer practice field. The PDI of tikka leaf spot & rust, yield data and economics of groundnut was recorded in both two years and pooled two years' data was presented in below mentioned tables.

Results and Discussions:

During 2022-23, the trial was conducted at three villages of Muthuku mandal and two villages of Chilakuru mandal of Nellore district. Groundnut is major crop in these two mandals and practicing as mono crop. Trial conducted villages are nearest two sea coast and crop is cultivating in sandy soils under irrigation condition. Every year the crop was severely infected with tikka leaf spot, at 70 days after sowing (DAS) complete defoliation occurs. Before initiation of trial, an average 5% of tikka leaf spot disease incidence was recorded in both demo and farmers practice. And also recorded 10% of rust PDI in both treatments before the initiating of trial. Kumar *et al*. (2019) conducted survey at different villages of Jhansi district and recorded highest 70% tikka leaf spot disease incidence in farmer's fields. In our experiments also recorded around 70% PDI of tikka leaf spot was recorded in farmers practice.

In demonstration plot, four fungicides were sprayed at 10 days' intervals starting from 30 DAS. First fungicide i.e. hexaconazole @ 2ml/lit at 30 DAS followed by tebuconazole @ 1ml/lit, then tebuconozole 50% +trifloxystrobin 25% WG @1.3g/ l and followed by pyraclostrobin 5% +metiram 55% WG @ 2 g/lit of water. 10 days after spraying of fourth fungicide i.e. pyraclostrobin 5% +metiram 55% WG, the PDI of tikka leaf spot and rust was recorded in both treatments i.e. demo plot and farmer practice plot. The PDI of tikka leaf spot 38.46% and 74.62% recorded in demo plot and farmer practice plot respectively. In case of rust, 5% of PDI was recorded in demo plot and 16% in farmer practice plot (Table.1). the incidence of tikka leaf spot was increased in both treatments but low incidence was recorded in demo plot than farmer practice. In farmer practice, they used single mode of action fungicides for spraying. The pathogen is developing resistance to single mode of action fungicides.

Table.01: PDI of tikka leaf spot & rust and economics of groundnut crop during Rabi, 2022-23

S. No.	Replications	Location	leaf spot (PDI)		Rust (PDI)		Yield (q/ha)		Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		B:C ratio	
			TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2
1	T. Teja	Lingavaram/	39	75	8	18	35	34	147000	154000	210000	204000	1.39	1.32

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*TO2-Farmer practicing plot
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		Chillakuru												
2	T. Upendhra	Lingavaram/ Chillakuru	35	74.3	8	14	36	35	153000	156000	216000	210000	1.41	1.35
3	Mallikarjuna	Narikelapalli/ Muthukuru	40	74	4	16	34	33	152000	161000	204000	198000	1.34	1.23
4	Subbaiah	Narikelapalli/ Muthukuru	43.28	78	6	18	34.8	34	150000	159000	208800	204000	1.39	1.28
5	Ch. Narayana	Balijepalem/ Muthukuru	35	71.8	4	14	35.2	34	153000	160000	211200	204000	1.38	1.28
		Average	38.46	74.62	5	16	35	34	151000	158000	210000	204000	1.38	1.29

Jadon *et al*. (2017) conducted experiment on management of foliar and soil borne diseases in groundnut and they concluded that the foliar disease severity was lowest in treatment tebuconazole and two foliar sprays of tebuconazole whereas it was recorded highest in the untreated control and also higher pod yield were recorded in seed treatment with mancozeb & two sprays of hexaconazole and seed treatment with tebuconazole & two foliar sprays of tebuconazole whereas it was lowest in the untreated control.

During 2023-24, the trial was conducted at Muthukur mandal and Buchireddypalem mandal of Nellore district. Before the trial initiated, tikka leaf spot incidence recoded 10% of PDI in both treatments, after initiation 38.8% and 65.4% PDI was recorded in demo plot and farmer practice plot respectively. And 5% of rust incidence recorded in demo plot where as in farmer practice 8% of rust PDI recorded (Table.2).

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Table.02: PDI of tikka leaf spot & rust and economics of groundnut crop during Rabi, 2023-24

S. No.	Replications	location	Leaf spot (PDI)		Rust (PDI)		Yield (q/ha)		Cost of cultivation (Rs./ha)		Gross Return (Rs./ha)		B:C ratio	
			TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2
1	Narayanaswamy	Muthukur	52	55	4	8	42	39.9	200000	202500	383500	280250	1.92	1.38
2	Mallikarjuna	Damaramadugu/ Buchireddypalem	28	75	4	10	52.5	50.4	195000	225000	368750	354000	1.89	1.57
3	Mastanaiah	Damaramadugu/ Buchireddypalem	48	72	5.6	10	47.25	44.1	205000	212500	331875	309750	1.62	1.46
4	Krishnaiah	Damaramadugu/ Buchireddypalem	41	70	6.8	8	50.4	45.15	225000	230000	360000	317125	1.6	1.38
5	Tejkumar	Muthukur	25	55	4.6	4	54.6	50.4	195000	200000	390000	360000	2	1.8
		Average	38.8	65.4	5	8	49.35	45.99	204000	214000	366825	324225	1.8	1.52

The two years mean data of tikka leaf spot PDI was recorded 38.63% in demo plot where as in farmer practice plot recorded 70% tikka leaf spot incidence. In case rust the mean PDI of 5% and 12% recorded in demo and farmer practicing plot respectively (Table.3). Kumar *et al*. (2019) conducted *in vitro experiments on* antifungal effects using eleven fungicides including Amistar Top (Strobilurin+Azole),– Amistar (Strobilurin), Natio, Score, Tilt, Lusture, Folicur, Contaf, Kavach, SAAF and Carbendazim. Of these Amistar Top and Amistar was effective (EC_{90}) at 20ppm concetration while EC90 value of Natio, Score, Tilt, Lusture, Folicur, Contaf and Kavach at <25ppm. And also they concluded that Strobilurin+Azole group fungicides also dominant in the field condition to control the disease.

Table.03: The impact of front line demonstration on yield and economics of groundnut

Season	Tikka leaf spot (PDI)		Rust (PDI)		Yield (q/ha)		Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)		B:C ration	
	TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2	TO1	TO2

2022-23	38.46	74.62	5	16	35	34	151000	158000	210000	204000	59000	46000	1.39	1.29
2023-24	38.8	65.4	5	8	49.35	45.99	204000	214000	366825	324225	162825	110225	1.8	1.52
Average	38.63	70.01	5	12	42.17	39.99	177500	186000	288412	264112	110912	78112	1.59	1.4

*TO1-Demonstration plot
*TO2-Farmer practicing plot

Sharma *et al*. (2020) conducted experiment on tikka leaf spot disease management using tebuconazole 50%+trifloxystrobin 25% WG, difenconazole 25% EC, hexaconazole 5% EC and tebuconazole 25.9% EC. Based on the results they concluded that the efficacy of combination fungicide of triazole and strobilurin group, *i.e.* tebuconazole 50%+trifloxystrobin 25% WG @ 0.25% concentration was found very effective against early and late leaf spots of groundnut and increasing the pod yield also. Our results agreed with Sharma *et al*. (2022) experiment results.

The data presented in table.3 revealed that in demo plot yield was found higher than farmer practice during the years of 2022-23 and 2023-24. In demo plot, recorded yield of 35 and 49.35 q/ha during 2022-23 and 2023-24 respectively. Where as in farmers practice, 34 and 45.99 q/ha during 2022-23 and 2023-24 respectively. An average 5% increased yield was recorded in demo plot over farmer practice. The less cost of cultivation was recorded in demo plot than farmer practice. The average net return recorded Rs.1,10,912/- in demo plot where as in farmer practicing plot Rs. 78,112/- net returns recorded. The benefit cost ration (B:C ratio) was 1.59 and 1.40 recorded in demo and farmer practicing plot respectively (Table.3). The cost of cultivation was more in farmer practice due to repeated spraying of fungicides for management of diseases.

In both treatments, tikka leaf spot disease recorded higher incidence, the reasons are in both treatments, farmers are cultivated TAG 24 variety due to high market value than other varieties and good table purpose value of seed but this variety is highly susceptible to foliar diseases. Dense plant population due to farmers are used high seed rate i.e. 200kg of seed per acre and micro sprinkle irrigation creating the higher humidity condition in crop climate. In these areas, groundnut is cultivating as monocrop, fungus developed higher pathogen inoculum and survived on plant debris in soils. Due to climatic changes and emergence of new virulent strains of pathogens is difficult to control the diseases effectively in groundnut. So, to formulate an effective, sustainable and location appropriate disease management practice, the study of the major diseases, its occurrence and symptoms becomes very important. The integrated disease management approaches can be useful in management of diseases in groundnut (Joshi *et al*.,2020).

Conclusion:

The combined mode of action chemicals is effective to control the disease than single mode of action chemicals. And also time of application is very important for controlling diseases. The demonstration of new molecules was found more effective than farmer practicing chemicals. Jadon *et al*., 2017 also suggested that the combination of treatments are most suitable for disease management.

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