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# Management of ground nut diseases by application of carbendazim + mancozeb (Wettable powder) under field condition

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## Abstract

Groundnut is an important edible oilseed crop. It suffers due to seed and soil borne fungal diseases. The new fungicide SAAF at the concentration of 2,2.5 and 3 kg were used as the seed treatment for the management. The Carbendazim 12% + Mancozeb 63% as wettable powder at the dose of 2.5 g /kg of seeds dose can effectively controlled Tikka Leaf spot, Dry root rot and collar rot diseases of groundnut, and recorded highest fruit yield. The SAAF in the combination with carbendazim and mancozeb showed multiple disease controlling mechanism.

**Keywords:** carbendezim, fungicide, mancozeb, phyto toxicity, SAAF.

## INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crops in the world. In India, it is cultivated over an area of 5.31million hectare with the production of 6.93 million tonnes (Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India). A large number of pathogens attack groundnut crop in India (Mayee and Datar, 1988). Among the soil-borne fungal diseases of groundnut, stem rot, also known as southern blight, southern stem rot, sclerotium rot or white mold caused by *Sclerotium rolfsii* Sacc., is a disease of economic significance throughout the world (Mehan *et al.,* 1994). The first symptom of stem rot/ sclerotium wilt /dry root is the sudden wilting of a branch which is completely or partially in contact with the soil. The leaves turn brown and wilt but remain attached to the plant.Dry root rot may appear at any stage of the growth of the crop. Water soaked necrotic spots appear on the stem just above the ground level. The lesions become dark as the infection spreads upwards the aerial parts and down into the roots. The entire stem becomes shredded and with the development of sclerotia becomes black and sooty in appearance. With the spread of crown rot/seedling blight *Aspergillus niger* infection spreads, the whole collar region becomes shredded and dark brown. Mature plants may also be attacked. Lesions develop on the stem below the soil and spread upwards along the branches. The dead dried branches are easily detached from the disintegrated collar region.

Peanut leaf spots are caused by two different fungi- *Cercospora arachidicola* (early leaf spot pathogen) and *Cercospora personata* (late leaf spot pathogen). It is difficult to distinguish between symptoms of early and late leaf spot. Early leaf spot usually causes brown lesions (spots) that are surrounded by yellow halo. Late leaf spot has become common recently and has been the most significant leaf spot disease for the past few growing seasons. Suitable crop rotation will decrease initial inoculums density of the pathogen and delay the infection and pathogenicity, thus reducing the disease severity and defoliation. Cercospora leaf spot disease reduces yield by 5.50-6.08g /plot for every unit increase in disease severity (Das and Roy, 1995) and this disease is responsible for reduction in protein content and oil recovery (Gupta *et al.*, 1987). Management strategy involves the use of tactics that reduce the rate of spread of disease by multiple applications of fungicide sprays and growing partially resistant cultivars (Agrios, 2005; Nutter and Shokes, 1995). Till date to the best of our knowledge, no cultivar resistance to soil borne diseases in groundnut has been reported. Fungicides are important component of the disease management program. Currently SAAF, which are contact and systemic fungicides, are registered for the control of diseases in Tamil Nadu. All of these fungicides provide effective control of foliar and soilborne diseases in groundnut. The SAAF 75 WP, a mixture of two fungicides (12 % carbendazim + 63% Mancozeb), is a curative and protective fungicide with broad spectrum systemic and contact activity in control of diseases in vegetables and fruits. This combination formulation has been found to effectively control major diseases of groundnut.

## MATERIALS AND METHODS

The field trial was conducted during July to October, 2013 at Tamil Nadu Agricultural University (TNAU) to evaluate the bio-efficacy of 12% Carbendazim + 63% Mancozeb WP against major diseases of groundnut.

### Application method

To treat the seeds, slurry with requisite quantity of test fungicide with 10 ml of water per Kg of seed was made and swirled in a closed container to make an uniform

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**Table 1.** Effect of Carbendazim (12%) + Mancozeb (63%) WP on seed germination of groundnut 10 days after sowing (Season I and II)

| Treatments | Product Dose (g/kg of seeds) | Season I | | Season II | |
|---|---|---|---|---|---|
| | | Percent germination | Percent increase in germination | Percent germination | Percent increase in germination |
| Carbendazim (12%) + Mancozeb (63% )WP | 2.0 | 79.67 (63.20) | 7.66 | 83.00 | 2.47 |
| Carbendazim (12%) + Mancozeb (63% )WP | 2.5 | 88.00 (69.73) | 18.92 | 93.00 | 14.81 |
| Carbendazim (12%) + Mancozeb (63% )WP | 3.0 | 89.67 (71.25) | 21.18 | 93.33 | 15.22 |
| Mancozeb (75% )WP | 2.5 | 80.00 (63.43) | 8.12 | 84.00 | 3.70 |
| Carbendazim (50%) WP | 2.0 | 81.67 (64.65) | 10.36 | 85.67 | 5.77 |
| Tebuconazole (2%) DS | 1.25 | 87.33 (69.15) | 18.01 | 91.33 | 12.75 |
| Carboxin (37.5%) + Thiram (37.5% )DS | 3.0 | 87.67 (69.44) | 18.47 | 92.67 | 14.41 |
| Untreated Control | - | 74.00 (59.34) | - | 81.00 | - |
| **CD Value** | | **2.80** | | **5.50** | |

Values are means of three replications. Figures in the parentheses represent arcsine transformed values. PDI; Per cent Disease Index.The common letters show non- significant differences among the treatments based on DMRT

**Table 2.** Effect of Carbendazim (12%) + Mancozeb (63% )WP on early leaf spot of groundnut (Season I and II)

| Treatments | Product Dose (g/kg seeds) | Season I | | | Percent reduction over control | Season II | | | Percent reduction over control |
|---|---|---|---|---|---|---|---|---|---|
| | | 30 DAS | 45 DAS | 60 DAS | | 30 DAS | 45 DAS | 60 DAS | |
| Carbendazim (12%) + Mancozeb (63% )WP | 2.0 | 4.00 (11.54)$^{b}$ | 5.10 (13.05)$^{b}$ | 5.39 (13.31)$^{b}$ | 57.39 | 5.22 (13.18)$^{b}$ | 6.80 (14.18)$^{b}$ | 7.33 (15.61$^{b}$ | 37.62 |
| Carbendazim (12%) + Mancozeb (63%) WP | 2.5 | 1.64 (7.27) $^{a}$ | 1.69 (7.27) $^{a}$ | 1.74 (7.49) $^{a}$ | 86.25 | 1.42 (6.80) $^{a}$ | 1.68 (7.27) $^{a}$ | 2.30 (8.62)$^{a}$ | 80.43 |
| Carbendazim (12%) + Mancozeb (63%) WP | 3.0 | 1.61 (7.27) $^{a}$ | 1.66 (7.27) $^{a}$ | 1.70 (7.49) $^{a}$ | 86.56 | 1.38 (6.55) $^{a}$ | 1.49 (6.80) $^{a}$ | 2.00 (8.13)$^{a}$ | 82.98 |
| Mancozeb (75%) WP | 2.5 | 3.56 (10.78)$^{b}$ | 5.10 (13.05)$^{b}$ | 5.31 (13.31)$^{b}$ | 58.02 | 5.20 (13.18)$^{b}$ | 6.00 (14.18)$^{b}$ | 7.18 (15.45)$^{b}$ | 38.89 |
| Carbendazim (50%) WP | 2.0 | 3.12 (10.14)$^{b}$ | 4.00 (11.54)$^{b}$ | 5.20 (13.18)$^{b}$ | 58.89 | 4.18 (11.68)$^{b}$ | 5.96 (14.06)$^{b}$ | 6.92 (15.23)$^{b}$ | 41.11 |
| Tebuconazole (2%) DS | 1.25 | 2.00 (8.10)$^{a}$ | 2.20 (8.33)$^{a}$ | 3.05 (9.97)$^{a}$ | 75.89 | 4.02 (11.54)$^{b}$ | 5.20 (13.18)$^{b}$ | 6.90 (15.23)$^{b}$ | 41.28 |
| Carboxin (37.5%) + Thiram (37.5%) DS | 3.0 | 1.80 (7.71)$^{a}$ | 2.19$^{a}$ (8.33) | 2.53 (9.10)$^{a}$ | 80.00 | 2.00 (8.13)$^{a}$ | 2.41 (8.91)$^{a}$ | 3.00 (9.97)$^{a}$ | 74.47 |
| Untreated Control | - | 8.33 (16.74)$^{c}$ | 10.67 (19.07)$^{c}$ | 12.65 (20.85)$^{c}$ | - | 7.18 (15.45)$^{c}$ | 10.00 (18.30)$^{c}$ | 11.75 (20.00)$^{c}$ | - |
| **CD Value** | | **1.75** | **1.63** | **2.60** | | **1.75** | **2.30** | **0.62** | |

Values are means of three replications. Figures in the parentheses represent arcsine transformed values PDI; Per cent Disease Index The common letters show non- significant differences among the treatments based on DMRT.

**Table 3.** Effect of Carbendazim (12%) + Mancozeb (63%) WP on Dry root rot of groundnut (season I and II)

| | Product Dose (g/kg seeds) | Plant rotting - Season I | | | Percent reduction over control | Plant rotting - Season II | | | Percent reduction over control |
|---|---|---|---|---|---|---|---|---|---|
| | | 30 DAS | 45 DAS | 60 DAS | | 30 DAS | 45 DAS | 60 DAS | |
| Carbendazim (12% )+ Mancozeb (63%) WP | 2.0 | 5.67 (13.78)$^{b}$ | 7.00 (15.34)$^{b}$ | 8.00 (16.43)$^{b}$ | 42.86 | 13.00 (21.13)$^{b}$ | 14.00 (21.97)$^{b}$ | 16.00 (23.58)$^{b}$ | 44.19 |
| Carbendazim (12%) + Mancozeb 63% WP | 2.5 | 2.33 (8.78)$^{a}$ | 3.00 (9.97)$^{a}$ | 3.67 (11.04)$^{a}$ | 73.79 | 5.33 (13.35)$^{a}$ | 5.67 (13.78)$^{a}$ | 6.00 (14.18)$^{a}$ | 79.07 |
| Carbendazim (12%) + Mancozeb (63%) WP | 3.0 | 2.33 (8.78)$^{a}$ | 2.67 (9.40)$^{a}$ | 3.33 (10.51)$^{a}$ | 76.21 | 4.33 (12.01)$^{a}$ | 4.67 (12.48)$^{a}$ | 5.00 (12.92)$^{a}$ | 82.56 |
| Mancozeb (75%) WP | 2.5 | 5.33 (13.35)$^{b}$ | 6.67 (14.97)$^{b}$ | 7.67 (16.08)$^{b}$ | 45.21 | 13.00 (21.13)$^{b}$ | 13.33 (21.41)$^{b}$ | 15.33 (23.05)$^{b}$ | 46.53 |
| Carbendazim (50%) WP | 2.0 | 5.00 (12.92)$^{b}$ | 6.00 (14.18)$^{b}$ | 7.33 (15.71)$^{b}$ | 47.64 | 13.00 (21.13)$^{b}$ | 13.00 (21.13)$^{b}$ | 15.00 (22.79)$^{b}$ | 47.68 |
| Tebuconazole(2%) DS | 1.25 | 3.33 (10.51)$^{a}$ | 3.67 (11.04)$^{a}$ | 4.33 (12.01)$^{a}$ | 69.07 | 12.00 (20.27)$^{b}$ | 12.33 (20.56)$^{b}$ | 14.00 (21.97)$^{b}$ | 51.17 |
| Carboxin (37.5%) + Thiram (37.5%) DS | 3.0 | 3.00 (9.97)$^{a}$ | 3.67 (11.04)$^{a}$ | 4.00 (11.54)$^{a}$ | 71.43 | 6.00 (14.18)$^{a}$ | 6.00 (14.18)$^{a}$ | 6.67 (14.97)$^{a}$ | 76.74 |
| Untreated Control | - | 7.00 (15.34)$^{c}$ | 11.67 (19.98)$^{c}$ | 14.00 (21.97)$^{c}$ | - | 20.00 (26.57)$^{c}$ | 24.00 (29.33)$^{c}$ | 28.67 (32.37)$^{c}$ | - |
| **CD Value** | | **1.81** | **1.75** | **2.01** | | **2.50** | **2.01** | **2.31** | |

Values are means of three replications. Figures in the parentheses represent arcsine transformed values. PDI; Per cent Disease Index. The common letters show non- significant differences among the treatments based on DMRT.

**Table 4.** Effect of Carbendazim (12%) + Mancozeb (63%) WP on collar rot of groundnut (Season I and II)

| Treatments | Product Dose (g/kg of seeds) | Plant rotting (%) | | | Percent reduction over control | Plant rotting (%) | | | Per cent reduction over control |
|---|---|---|---|---|---|---|---|---|---|
| | | 30 DAS | 45 DAS | 60 DAS | | 30 DAS | 45 DAS | 60 DAS | |
| Carbendazim (12% )+ Mancozeb (63%) WP | 2.0 | 12.00 (20.27)$^{b}$ | 12.67 (20.85)$^{b}$ | 15.00 (22.79)$^{b}$ | 50.00 | 4.33 (12.01)$^{b}$ | 6.00 (14.18)$^{b}$ | 7.67 (16.08)$^{b}$ | 52.06 |
| Carbendazim (12%) + Mancozeb (63%) WP | 2.5 | 5.00 (12.92)$^{a}$ | 5.33 (13.35)$^{a}$ | 5.67 (13.78)$^{a}$ | 81.10 | 1.33 (6.62)$^{a}$ | 1.67 (7.43)$^{a}$ | 2.00 (8.13)$^{a}$ | 87.50 |
| Carbendazim (12)% + Mancozeb (63)% WP | 3.0 | 4.00 (11.54)$^{a}$ | 4.00 (11.54)$^{a}$ | 4.67 (12.48)$^{a}$ | 84.43 | 0.67 (4.70)$^{a}$ | 1.33 (6.62)$^{a}$ | 1.67 (7.43)$^{a}$ | 89.56 |
| Mancozeb (75%) WP | 2.5 | 11.00 (19.37)$^{b}$ | 12.33 (20.56)$^{b}$ | 14.00 (21.97)$^{b}$ | 53.33 | 4.00 (11.54)$^{b}$ | 5.67 (13.78)$^{b}$ | 7.33 (15.71)$^{b}$ | 54.19 |
| CarbSendazim (50%) WP | 2.0 | 11.00 (19.37)$^{b}$ | 12.33 (20.56)$^{b}$ | 13.67 (21.70)$^{b}$ | 54.43 | 3.67 (11.04)$^{b}$ | 5.33 (13.35)$^{b}$ | 6.67 (14.97)$^{b}$ | 58.31 |
| Tebuconazole (2%) DS | 1.25 | 6.00 (14.18)$^{a}$ | 6.00 (14.18)$^{a}$ | 6.67 (14.97)$^{a}$ | 77.77 | 1.67 (7.43)$^{a}$ | 2.33 (8.78)$^{a}$ | 3.00 (9.97)$^{a}$ | 81.25 |
| Carboxin (37.5%) + Thiram (37.5%) DS | 3.0 | 5.33 (13.35)$^{a}$ | 5.67 (13.78)$^{a}$ | 6.33 (14.57)$^{a}$ | 78.90 | 1.67 (7.43)$^{a}$ | 2.00 (8.13)$^{a}$ | 2.67 (9.40))$^{a}$ | 83.31 |
| Untreated Control | - | 18.67 (25.60)$^{c}$ | 22.00 (27.97)$^{c}$ | 30.00 (33.21)$^{c}$ | | 7.33 (15.71)$^{c}$ | 12.00 (20.27)$^{c}$ | 16.00 (23.58)$^{c}$ | - |
| **CD Value** | | **2.81** | **3.10** | **2.78** | **1** | **2.85** | **2.30** | **2.70** | |

Values are means of three replications. Figures in the parentheses represent arcsine transformed values. PDI; Per cent Disease Index. The common letters show non- significant differences among the treatments based on DMRT

**Table.5.** Effect of Carbendazim ( 12%) + Mancozeb(63%) WP on yield of groundnut (Season I and II)

| Treatments | Product Dose (g/kg of seeds) | Season I | | Season II | |
|---|---|---|---|---|---|
| | | Yield (q/ha) | Increased Yield over Control | Yield (q/ha) Increased Yield over Control | |
| Carbendazim (12%) + Mancozeb (63%) WP | 2.0 | 6.85[b] | 24.55 | 7.30[b] | 29.89 |
| Carbendazim (12%) + Mancozeb 63% WP | 2.5 | 9.23[a] | 67.82 | 10.95[a] | 94.84 |
| Carbendazim (12%) + Mancozeb (63%) WP | 3.0 | 9.50[a] | 72.72 | 11.10[a] | 97.51 |
| Mancozeb(75%)WP | 2.5 | 6.95[b] | 26.36 | 7.56[b] | 34.52 |
| Carbendazim (50%) WP | 2.0 | 7.00[b] | 27.27 | 7.70[b] | 37.01 |
| Tebuconazole (2%) DS | 1.25 | 8.92[a] | 62.18 | 9.46[a] | 68.33 |
| Carboxin (37.5%)+ Thiram (37.5% )DS | 3.0 | 9.00[a] | 63.64 | 9.75[a] | 73.49 |
| Untreated Control | - | 5.50[c] | - | 5.62[c] | - |
| **CD Value** | | **1.30** | | **1.68** | |

Values are means of three replications. The common letters show non- significant differences among the treatments based on DMRT.

coating over the seeds. Coated seeds were then shade dried and sown on the next day.

The variety of groundnut used was TMV – 7 with spacing of 30cm x 10cm and number of plants per plot were 666 plants . All the standard agronomic practices were followed as per the recommendations of the University. The evaluation of the test fungicide was done along with standard checks and untreated control against the incidences of tikka leaf spot (early leaf spot) dry root rot and collar rot diseases of groundnut.

The observations on germination were recorded on 10$^{th}$ day after sowing. For tikka leaf spot disease 15-leaves randomly selected from five groundnut plants/plot were assessed for scoring the incidence of diseases. The observation on leaf spot and soil borne diseases were recorded on 30, 45, and 60 days after sowing.

**Statistical analysis**

The design followed was Randomized Block Design (RBD) with three replications. The data were statistically analyzed (Gomez and Gomez, 1984). The PDIs and percent rotting data were suitably transformed into arcsine values, analyzed and presented with DMRT symbols. The weights of harvested groundnut pods were summed up for calculating plot-wise total yield and converted into q/ha and statistically analyzed.

## RESULTS AND DISCUSSION

**Seed treatment on seed germination:**

Seed treatment with different chemicals indicated significant improvement in seed germination as compared to untreated plots. Maximum germination (89.67%) was recorded in plots treated with 12% Carbendazim + 63% Mancozeb WP @ 3.0 g/kg seeds which was at par with middle dose of Carbendazim 12% + Mancozeb 63% WP @ 2.5 g/kg seeds (88.00%), Carboxin 37.5% + Thiram 37.5% DS @ 3.0 g/kg seeds (87.67%) and Tebuconazole 2% DS @ 1.25 g/kg seeds (87.33%). Gururaj, (2012) found that foliar application of Carbendazim with Mancozeb @ 2g/L was found to be highly effective in the management of late leaf spot and rust of groundnut with higher pod yield (2768 kg/ha) and benefit cost ratio (2.50). Further, Carbendazim+Mancozeb @ 2 g/L was superior not only in controlling diseases, but also resulted in higher per cent increase in pod yield in farm trials and large scale demonstration trials conducted in farmers fields for three kharif seasons at Raichur, India, Findings with respect to disease management of late leaf spot and rust under field condition by use of fungicides were well endorsed by earlier workers (Shekawat *et al.*, 1985; Mittal, 1996; Dubey, 1997; Dubey and Mishra, 1992). Earlier, leaf spots and rust were reported to be managed by spraying of carbendazim and mancozeb

with higher pod yield (Vidyasekharan, 1981; Shekawat *et al.*, 1985; Mittal, 1996; Dubey, 1997). The effectiveness of chlorothalonil was also better in comparision to mancozeb and carbendazim and the similar results are demonstrated by others (Dubey and Mishra, 1992; Dubey, 1997)

**Effect on Dry Root Rot and Collar rot**

Data obtained from seed treatment of Carbendazim 12% + Mancozeb 63% WP @ 3.0 g /kg of seeds provided the maximum control (4.67 % rotting) of the Dry root rot disease at 45 Days after Seed treatment (DAS) which was at par with Carbendazim 12% + Mancozeb 63% WP @ of 2.5 g /kg of seeds (5.67% rotting) and standard check Carboxin 37.5% + Thiram 37.5% DS @ 3.0 g /kg of seeds (6.00% rotting). Seed treatment with different chemicals provided significant control of collar rot disease. Data obtained from seed treatment of Carbendazim 12% + Mancozeb 63% WP @ 3.0 g /kg of seeds provided the maximum control (4.00% rotting) of the collar rot disease at 45 DAS which was on par with Carbendazim (12%) + Mancozeb (63%) WP @ of 2.5 g / kg of seeds (5.18% rotting), Carboxin (37.5%) + Thiram 37.5% @ 3.0g /kg of seeds (5.62% rotting) and Tebuconazole (2%) DS @ 1.25 g /kg of seeds (6.00% rotting). These treatments were found significantly superior over rest of the chemicals. Though this fungus is seed as well soil borne but soil-borne are more significant in disease development. The pods, which are produced below the soil surface, come in contact with the fungi causing rotting of pods. This results in lowering of yield and quality of pods.For the management of diseases SAAF is an protective and contact fungicide with site specific activity and multi site inhibitor activity. The mixture of carbendazim and mancozeb offers different mode of action that comes in contact with the soil and seeds gives protection to the pods and reduce the damages to pegs.The mycelium coveing the pods are killed thereby reducing the incidences of various diseases

**Effect on Early Leaf Spot of Groundnut *(Cercospora personata):***

All the treatments were more effective in comparison to untreated control. However, seed treatment of Carbendazim (12%) + Mancozeb (63%) WP @ 3.0 g/kg of seeds provided the maximum control (PDI 1.49) of the early leaf spot disease at 45 DAS which was on par with Carbendazim (12%) + Mancozeb (63%) WP @ of 2.5 g /kg of seeds (PDI 1.68) and standard check Carboxin (37.5%) + Thiram (37.5% )@ 3.0 g /kg of seeds (PDI 2.41). A single spray of Carbendazim + Mancozeb was applied once in different treatments and spray timings varied from 30 DAS to 80 DAS at 10 days intervals reduced the per cent disease index in all treatments. The sprays conducted up to 50 DAS produced significantly more yield than later applications (Chandra *et al.*, 1998).

**Phytotoxicity**

Carbendazim (12%) + Mancozeb( 63%) WP at treatments at 2.0, 2.5, 3.0 and 6.0 g /kg of seeds doses were assessed for the phytotoxicity alongwith standard checks. The observation of different parameters revealed that all the doses of Carbendazim (12%) + Mancozeb (63%) WP didn't show any phytotoxicity sign or symptoms in comparison to other treatments. The crop stand and the crop growth were normal at every stage of observations (5, 10, 15, 20, 30 and 45 days after crop germination) Rakholiya *et al.* (2012) found that during experimental period, no phototoxic effect was observed for above fungicides as seed dressers at tested concentrations.

**Yield**

Carbendazim (12%) + Mancozeb (63%) WP @ of 3.0 g /kg of seeds dose treatment recorded maximum yield of 9.50 q/ha which was at par with the spray treatment of Carbendazim 12% + Mancozeb (63% )WP @ 2.5 g/kg dose (9.23 q/ha), Carboxin (37.5%) + Thiram (37.5%) DS @ 3.0 g/ha (9.00 q/ha) and Tebuconazole (2%) DS @ 1.25 g /kg of seeds (8.92 q/ha). The collar rot disease expresses its symptoms in pre and post emergence phases. This disease is extensively damaging in kharif season. These treatments provided significant increase in yield ranging between 72.72 and 62.18 per ent. The maximum pod yield (1632 kg/ha) were recorded in treatment of vitavax 200wp (4g/kg seed) (Rakholiya *et al.*, 2012).

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