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EFFICACY OF SEQUENTIAL SPRAYS OF DIFFERENT FUNGICIDES AGAINST EARLY BLIGHT *ALTERNARIA SOLANI* (ELLIS AND MARTIN) IN POTATO *SOLANUM TUBROSUM* L.

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ABSTRACT

The main constraint to potato farming in Maharashtra is vulnerable to insect-pests and disease hence implying a high risk of failure and the crop needs intensive care and attention. Among the various diseases, early blight, caused by Alternaria solani (Ellis and Martin) is a serious disease of potato that occurs in most potato growing regions of Maharashtra. Several effective pesticides have been recommended against this pathogen, but they not considered a long-term solution, due to concerns of expense, exposure risks and the hazards of its residues. Moreover, the development of resistance of pathogenic fungi towards synthetic pesticides is a great problem that can affect significantly the efficacy of chemical fungicides. Therefore, keeping in view, the devastating nature of disease and to find safe and environmentally friendly fungicides a detailed investigation was undertaken under field conditions to devise management programme of the disease. An experiment on efficacy of sequential sprays of different fungicides against early blight A. solani was conducted during kharif 2017 season on potato. The experiment was laid out in RBD design with four treatments and five replications. The results revealed that spray of mancozeb 75 WP (0.25%) @ 2.5 gm/ liter of water followed by hexaconazole 5 EC (0.05%) @ 0.5 ml /liter of water and then mancozeb 75 WP (0.25%) @ 2.5 gm/ liter of water at 10 days interval was found significantly superior in controlling the early blight disease of potato and also recorded significant highest yield (22.40 t/ha) as compared to other treatments.

KEY WORDS

Potato, Alternaria solani, Hexaconazole, Mancozeb

INTRODUCTION:

Potato (*Solanum tuberosum* L.) is one of the most important staple food and cash crop belonging to the family solanaceae. In India, the potato is not only primarily a rural staple but a cash crop that provides significant income for farmers. It is grown in all the states producing 46 million tonnes from total area of 2.0 million ha during year 2014 (Anon., 2016). It is a cool season crop and a temperature up to 24 ° C is considered best for the growth of young plants. However, the production of tubers is ideal at 20 °C. The various factors limiting yield of potato include lack of high yielding varieties, inadequate supply of healthy seed tubers and high incidence of disease and pest. The crop is susceptible to many diseases, some of which are widespread and others are localized. The causal agents of these diseases include fungi, bacteria, viruses, Phytoplasmas, viroids and nematodes. The intensive and extensive cultivation under the most favorable environmental conditions for potato crop production in the state failed to provide significant strides in potato yields, because of a number of production constraints.

Among all these diseases early blight caused by *Alternaria solani* (Ellis and Martin) is one of the very important, old and well-known diseases of potatoes. This disease has been underrated contrast to the more spectacular late blight disease. However, in many areas the average annual loss from this disease exceeds the losses from late blight. Yield loss is upto 6-40%. In India it is first reported in Farukabad (U.P) in 1903. In recent years, increase in *A. solani* disease on potato foliage has been reported in various potato growing areas (Vloutoglou and Kalogerakis, 2000). A high frequency of potato or tomato cropping in one field, as well as consecutive plantings of potatoes or tomatoes, are associated with an earlier appearance of initial early blight lesions (Shtienberg & Fry 1990). Disease symptoms are characteristic dark brown to black lesions with concentric rings which initially observed on older, senescing leaves. It spreads and inflicts damage to stems, petioles and tubers in epidemic form and resulting in tuber yield reduction. Yield loss estimates resulting from foliar damage incited by early blight on potato vary by location and cropping pattern.

Tuber yield is only 12.06 t/ha in the country which is lower as compared to other potato growing countries of the world. In the Ukraine and the Netherlands potato yield is 44.0 and 41.3 t/ha respectively, (Swaminathan, 2000). As such, most commercial potato farmers rely on fungicide applications for control of *Alternaria solani*. Early blight can be controlled by efficient use of cultural practices, such as a 3–5-year crop rotation with non-host crops, site selection, sanitation of fields, providing proper plant nutrition, avoiding water stress and planting disease-free seed (Madden *et al*. 1978). Management of early blight of potato requires an integrated approach that includes rotation with non-hosts, resistant cultivars, cultural practices, and fungicides. Therefore, keeping in view, the devastating nature of disease and to find safe, efficacious and environmentally friendly fungicides a detailed investigation was undertaken under field conditions to devise management programme of the disease.

MATERIALS AND METHODS

The experiment was conducted under all India Coordinated Research Project, on Potato, National Agricultural Research Project, Ganeshkhind, Pune. The field experiment was carried out during *kharif* season of 2017 in a farmer's field at at Kodit Tal: Purandar Dist: Pune. The experimental plot was well ploughed. Recommended doses of fertilizers and manure were applied as per standard agronomic practices. Seeds of potato variety, Khufri Pukharaj were used. The experiment was laid out in a Randomized Block Design (RBD) with five replications. The unit plot size was 3.0 × 2.0 m^2. Spacing of row to row (within plot) and tuber to tuber (within row) was 60 cm and 20 cm, respectively. Two times weeding was done at an interval of 30 days. Earthing up was executed two times throughout the entire growing period, one at 30 days and another one at 60 days after planting.

The sequential sprays of different recommended fungicides were evaluated for their efficacy against *A. solani*. in potato crop. The treatments were: T1: Unsprayed control, T2: spray of urea (1%) + mancozeb @ 0.25% at 40-45 days crop age and repeat at 10 days interval, T3: spray of urea (1%) + mancozeb @0.25% at 40-45 days crop age and repeat at 10 days interval followed by one more spray of mancozeb T4: first spray of mancozeb 75WP (0.25%), second spray of hexaconazole 5EC (0.05%) and third spray of mancozeb 75WP (0.25%) at 10 days interval. In control treatment, equal amount of plain water was sprayed. Spray was initiated as soon as the first disease intensity in traces was notices. Subsequent two sprays were given at an interval of 10 days. Care was taken during spray both the upper and lower surface of leaves as well as stems was well covered by fungicidal solution. Spray tank was thoroughly washed before filling fungicidal solution materials. The disease incidence was calculated by counting total number of plants per treatment/replication and among which an infected plant. The disease intensity of early blight of potato was recorded from the randomly selected 5 plants per plot based on 0-5 scale (Mayee and Datar, 1986). Disease intensity was monitored one day before each spray and final observation on PDI (Per cent Disease Index) was recorded 10 days after final spray.

The yield of potato was recorded after harvesting (tones/ ha). Data on yield of potato and percentage of disease index was statistically analyzed (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

Results regarding per cent incidence and per cent intensity of early blight disease of potato and tuber yield (tones) per hectare after crop harvest are presented in

Table-1. The results indicated that all the sequential fungicidal treatments had significantly less early blight disease incidence and intensity than unsprayed control. The incidence and intensity of early blight was ranged from 4.65 to 38.66 and 2.40 to 33.60 per cent respectively during experimentation. The final score recorded at 40 days after spray revealed that significantly minimum (17.26%) disease incidence was observed in treatment of sequential spray of mancozeb 75WP (0.25%) followed by hexaconazole 5EC (0.05%) and then spray of mancozeb 75WP (0.25%) at 10 days interval than the rest of treatments, whereas significantly higher disease incidence was observed in unsprayed control (38.66%). The incidence of disease was increased gradually over the period of experiment in all treatments including unsprayed control.

Observations on disease severity was recorded before the first spray, which was found non-significant indicating that there is no significant difference between the treated and the unsprayed control. However, later it was observed that at 10, 20,30 and 40 DAS the treatment differs significantly over the unsprayed control. The disease intensity at 10 days after first spray in all the treatments ranged from 4.80 to 10.40 per cent irrespective of the treatments. Among the treatments at 40 days after spray, sequential spray of mancozeb 75WP (0.25%) followed by hexaconazole 5EC (0.05%) and then spray of mancozeb 75WP (0.25%) at 10 days interval had significantly less disease severity (12.00% PDI) than rest of treatments. It was followed by sequential spray of urea (1%) + mancozeb @ 0.25% at 40-45 days crop age and repeat at 10 days interval which was on par with sequential spray of urea (1%) + mancozeb @0.25% at 40-45 days crop age and repeat at 10 days interval followed by one more spray of mancozeb. Ganie (2012) evaluated different systematic and non-systematic fungicides against early blight of potato crop and reported that mancozeb and hexaconazole found effective in reducing disease severity.

Tuber yield per hectare was significantly higher in all the fungicidal treatments than unsprayed control. Amongst sequential applications, spray of mancozeb 75WP (0.25%) followed by hexaconazole 5EC (0.05%) and then spray of mancozeb 75WP (0.25%) at 10 days interval had significantly higher tuber yield (22.40 t ha-1) than rest of the treatments. Next best treatment was spray of urea (1%) + mancozeb @ 0.25% at 40-45 days crop age and repeat at 10 days interval and which was on par with sequential spray of urea (1%) + mancozeb @0.25% at 40-45 days crop age and repeat at 10 days interval followed by one more spray of mancozeb.

The various cultural practices can reduce the severity of early blight, but under situations of sufficient inoculum and environmental conditions favourable for disease, complete control will not be achieved. The most effective control method is a protectant fungicide spray programme used from early in the growing season. Proper timing of initial and subsequent fungicide applications can reduce the overall number of sprays with no significant loss in yield. The results of the present investigation indicate that the sequential fungicidal treatments (T4) significantly reduced disease severity and increased yield over control. This is in accordance with the findings of Sinha and Prasad (1991) and Ganie (2012) claimed that the best control of disease caused by *Alternaria solani* was achieve by mancozeb at 0.2 percent and hexaconazole 0.05 per cent at field condition. Further they reported that treatment was also the most cost effective and gave the highest yields. All these findings are in agreement with the present findings of study. Considering findings of the present investigation it may be concluded that sequential spraying of spray of mancozeb 75 WP (0.25%) @ 2.5 gm/ liter of water followed by hexaconazole 5 EC (0.05%) @ 0.5 ml /liter of water and then mancozeb 75 WP (0.25%) @ 2.5 gm/ liter of water at 10 days interval can be used as alternative for management of early blight of potato as the pathogen reported fungicide resistance to common fungicides.

Table 1: Efficacy of different fungicidal sprays against disease severity of early blight on potato.

Sr.No	Treatment Details	Diseases incidence of early blight after application of sprays (%)					Diseases severity of early blight after application of sprays (%) PDI					Yield (t/ ha)
		Pre-rating	10	20	30	40	Pre-rating	10	20	30	40	
T_1	Control	6.62 (14.78)	18.87 (25.54)	26.47 (30.80)	32.62 (34.73)	38.66 (38.36)	3.20 (9.55)	10.40 (18.73)	16.80 (24.18)	22.40 (28.09)	33.60 (35.18) *	13.80
T_2	Spray of urea (1%) + mancozeb @ 0.25% at 40-45 days crop age and repeat at 8-10 days interval	5.69 (13.09)	14.14 (21.86)	16.01 (23.36)	17.41 (24.48)	18.87 (25.71)	5.60 (13.49)	8.00 (16.22)	12.00 (19.68)	16.00 (23.51)	20.80 (26.77)	18.80
T_3	Spray of urea (1%) + mancozeb @0.25% at 40-45 days crop age and repeat at 8-10 days interval followed by one more spray of mancozeb	7.16 (14.43)	15.26 (22.90)	18.54 (25.42)	20.52 (26.73)	24.36 (29.22)	2.40 (8.54)	8.80 (17.20)	12.80 (20.76)	17.60 (24.77)	22.40 (28.09)	17.60
T_4	First spray of mancozeb 75WP (0.25%), second spray of hexaconazole 5EC (0.05%) and third spray of mancozeb 75WP (0.25%) at 10 days interval	4.65 (11.92)	11.67 (19.91)	13.11 (21.09)	15.42 (22.97)	17.26 (24.43)	4.00 (11.01)	4.80 (12.52)	8.00 (16.43)	10.40 (18.73)	12.00 (20.16)	22.40
	S.E.±	1.88	1.23	1.61	1.92	20.07	1.52	1.40	1.25	1.23	1.67	1.15
	C.D. @ 5%	NS	3.80	4.99	5.91	6.37	4.68	3.21	3.85	3.96	5.15	3.53

***Figures in parenthesis are arcsine transformed values.**

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