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Castor Fusarium Wilt: A Major Threat to Castor Production in India and Its Management

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Abstract

Castor is an important non-edible oilseed crop with diverse industrial value. India is a major producer of castor in the world. However, the productivity is low especially in the rainfed regions due to the incidence of pests and diseases. Fusarium wilt is the most destructive seed and soil borne disease in castor. The disease is seen in all the major castor growing states in India and can cause yield losses up to 80%. Though several management methods are available, host plant resistance is the most effective approach to manage the disease. Significant progress in identification of resistant sources and development of wilt resistant cultivars has been made in the past three decades. However, breakdown of resistance to wilt has been observed necessitating the development of durable resistance. In this article, the problems with castor production, incidence of wilt, management strategies and future outlook have been discussed.

Introduction

Castor (*Ricinus communis* L.) is a prominent oilseed crop grown in the arid and semi-arid regions of the world. India leads the globe with respect to the area occupied in castor cultivation at 1.05 mha with a production of 1.8 metric tonnes and a productivity of 1800 kg/ha. Though the production and productivity have increased over the last few decades, the general productivity of castor in rainfed areas is very low. There is a wide gap between the potential yields in research stations and on farm yields in farmers' fields of several castor high yielding varieties due to-

- Use of poor quality seed.
- Low input supply.
- Cultivation in sub-marginal and marginal lands.
- Prevalence of biotic stresses like drought.
- Frequent incidence of pests and diseases.
- Lack of efficient management practices.

More than 25% yield losses are attributed to the incidence of pests and diseases in castor. The crop is affected by different pathogens at every stage of the crop growth resulting in economic losses. Wilt, root rot and grey mold are the major diseases especially in high yielding varieties and hybrids.

Fusarium Wilt - Threat to Castor Production

Wilt caused by *Fusarium oxysporum* f. sp. ricini (Nanda and Prasad) is the most important seed and soil borne disease of castor. The disease was first reported in India in 1974 in Udaipur, Rajasthan. In less than five decades, the disease has spread to all the castor

growing regions in the India. Today, wilt stands as one the most important threats to castor growers all across the country owing to continuous cultivation of castor in the same field resulting in endemic development and the ability of the pathogen to attack the crop at any stage of its growth. The disease is a serious problem in irrigated conditions. Losses due to wilt depend on the stage of attack ranging from-

• 77% at flowering.

• 63% at 90 days.

• 39% at later stage of secondary branch production.

• 8-14% loss in seed weight.

• 1-2% loss in seed oil content.

• Overall loss of 10-40% in yield.

Yield reduction of 1.86 kg/ha with each percent incidence of wild disease has been observed in Andhra Pradesh, thus realizing the economic importance of the disease.

Etiology and Symptomatology

The fungus produces abundant white mycelial growth and forms microconidia and macroconidia. Microconidia are hyaline, oval to round, aseptate or single septate and macroconidia are hyaline, 2-6 septate, straight, spindle or sickle shaped. The disease occurs throughout the year in patches at all crop growth stages. Symptoms are prominent at flowering, spike formation and capsule maturation stages. Young seedlings exhibit discoloration of hypocotyl, loss of turgidity with/without change in leaf colour. Drooping of the plants with few top leaves after drying and dropping of all the affected lower leaves is a characteristic symptom and ultimately plants die. Clusters of purple colored sporodochia can be seen under humid weather conditions. Brownish discoloration and white cottony mycelial growth is seen in the pith region of split open stem. The disease is aggravated in the presence of reniform nematode *Rotylenchulus reniformis.*

Integrated Disease Management

Owing to seed and soil-borne nature, wilt disease is difficult to control using a single approach. Hence, it is imperative that wilt management is based on integration of the following host plant resistance, cultural practices, physical methods, biological control and chemical methods for sustainable castor cultivation (Kumar *et al.,* 2015).

• **Host plant resistance**: Adoption of wilt resistant varieties and hybrids like Jwala (48-1), Jyothi (DCS-9), Haritha (PCS 124), PCH 111, PCH 222, DCS 519 *etc*.

• **Soil solarization**: with Soil has to be ploughed to depth of 30 cm twice before solarization during 3rd week of April and irrigated through pipes up to saturation and then covered with transparent low density polyethylene sheet (LDPE) of gauge 200 µm during peak summer season *i.e*., 16-21 standard weeks of the year. Six weeks of soil solarization can increase the soil temperature by 10 °C in the top 5 cm resulting in 50% reduction in wilt incidence and 35% reduction in inoculum load.

• **Crop rotation**: 2-3 year crop rotation with non-host crops like finger millet, pearl millet or other cereals to reduce the inoculum in soil.

• **Intercropping**: Inter cropping with pigeon pea (1:1) is effective for minimum wilt incidence. Intercropping urd bean with castor (6:1) have proved to result in land equivalent ratio but also high seed yield.

• Avoid cultivation of castor in low lying areas and ill drained conditions.

• Roguing of wilt infected plants regularly to reduce the build up of inoculum and disease spread.

• **Chemical Control**

✓ Soaking the infected seed in carbendazim @ 0.1% for 24 h and slurry treatment can significantly improve germination and reduce wilt incidence.

✓ Seed treatment with carbendazim 2 g/kg seed.

✓ Soil drenching with carbendazim 3 g/l or copper oxy-chloride near the base of the affected and the surrounding plants to restrict the spread of the disease.

• **Biological Control**

✓ Application of farm yard manure (10 t/ha) + neem cake (1 t/ha) + seed treatment with *Trichoderma viride* (10 g/kg).

✓ Soil application of *T. viride* (2.5 kg) mixed with FYM (125 kg/ha) + seed treatment with *T. viride* (10 g/kg).

Future Outlook

India has seen significant strides in castor improvement with identification of high yielding cultivars with resistance to wilt and development of efficient screening techniques to identify wilt resistance. However, many gaps still exist in our knowledge on fusarium wilt resistance in castor. Some future strategies include-

• Understanding the underlying mechanism of wilt resistance.

• Development of standard differential set for Fusarium wilt to determine and differentiate the races.

• Identification of race-specific resistant genes and pyramiding in a single genotype for long perpetuation of the cultivars.

• Develop durable resistant genotypes by screening under heavy inoculum load.

• In depth study on the genetics and genomics of resistance to wilt disease.

• Understanding breakdown of resistance in wilt resistant cultivars.

• Histological characterization of resistance.

• Induced systemic resistance by microorganisms or chemicals as an eco-friendly management strategy.

• Mapping quantitative trait loci (QTL) for castor wilt disease to aid in marker assisted selection (MAS) breeding in castor.

Conclusion

Fusarium wilt is a devastating disease affecting the castor cultivation throughout India. The pathogen can attack the crop from seedling to maturity stage and cause significant yield losses. Adoption of an integrated disease management approach using host plant resistance, physical, cultural, biological and cultural practices can reduce the incidence of wilt for sustainable castor cultivation. Though significant progress has been made with regards to resistance, screening and management, it is critical to strengthen future research on understanding the genetic control of resistance to Fusarium wilt in castor.

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