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Zinc Deficiency Management in Rice for Higher Productivity

Rice (*Oryza sativa* L.) is one of the highly sensitive crops to zinc deficiency. Zinc is the most important micronutrient limiting rice growth and yield next to nitrogen and phosphorus. Soil having coarse texture, low organic matter content, high pH and presence of $CaCO_3$ are prone to zinc deficiency. Zinc deficiency usually appears in 2 to 3 weeks after transplanting rice seedlings. It affects tiller production, plants remain stunted and in severe cases complete crop loss may occur. Also it increases the spikelet sterility and time to crop maturity. It can be managed by soil application and foliar spray of zinc fertilizers. Soil application of zinc sulphate through broadcasting and incorporation proved more efficient and economical method for correcting the zinc deficiency.

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food of the nation and worldwide for more than 50% of the population, serving as a cheaper source of energy through bulk amounts of carbohydrates. Soil factors such as high soil pH (>7.0), low available Zn content, prolonged submergence and high organic matter favours occurrence of zinc deficiency in rice.

Zn deficiency in rice usually appears in 2 to 3 weeks after transplanting of rice seedlings. First the older leaves develop brown spots and streaks that may enlarge and join together and the entire leaf become reddish brown colour. Growth of plants remains stunted and tiller production also reduced. After 4 weeks of transplanting, plants will recover and show substantial delay in maturity and reduction in yield. It causes 20-60 per cent grain yield loss and in some cases complete crop loss is noticed. Hence, zinc deficiency management aspects should be ensured to supply adequate zinc from nursery to maturity by systematic approaches.

MANAGEMENT OF ZINC DEFICIENCY IN NURSERY

Early seedling vigour is attributed by the zinc contents in seeds, but most of the high yielding varieties have less than 14 ppm/ g of seed. It leads to zinc deficiency in seedlings. Nursery should be applied with green/green leaf manures in advance before sowing of seeds. They should be properly incorporated by cage wheel ploughing using power tiller. Raised Beds should be prepared according to the needs of the seed rate required per acre. Application of Di-ammonium phosphate or Single super phosphate should be avoided in the nursery. Nursery should be supplemented with bio inputs for nutrient supply to avoid fixation of zinc with carbonates and bicarbonates.

Figure 1. Zinc Deficiency in Main Field

SEED TREATMENT WITH BIO FERTILIZERS AND PRIMING WITH ZINC

Seeds required for one acre area (10 kg) with 25x25 cm spacing and two seedlings per hill should be used treated with 0.1% solution of *Azospirillum* and Phosphobacteria for overnight soaking (1 kg of each in 100 litres of water). Seeds containing a gunny bag should be immersed in the solution overnight. The second day morning, seeds should be taken out from the solution and kept in shade. Evening during 4-6 pm, the volume of solution again should be made up to 100 litres and added with 1 g of zinc sulphate (100ppm) and primed for 2 hours. After priming, gunny bag containing seeds should be removed from solutions and shade dried. Third day morning, pre germinated seeds inoculated with bio-fertilizers and primed with zinc are ready for sowing in the nursery.

For each bed, 3.0-3.5 kg of seeds is needed and should be spatially sown to produce vigorous seedlings. Paddy straw or shade net may be covered on the beds to provide shade. Watering should be done every day using rose canes. Five days after sowing the shade cover should be ready and regular watering should be done. On 12th day, foliar spraying of zinc EDTA @ 0.2 % + 19:19:19 @ 0.5% should be done. About 15-16 days, seedlings will be ready for transplanting.

MANAGEMENT OF ZINC DEFICIENCY IN MAIN FIELD

GREEN MANURE APPLICATION

Two months before the transplanting rice seedling, seeds of green manure crop *viz.,* dhaincha should be broadcasted @ 20 kg/acre. Required irrigation should be given (once in 15-20 days) based on climatic conditions. During flowering initiations, the crop should be incorporated by cage wheel ploughing and allowed for decomposition for a week, prior to planting, the field is ploughed and levelling should be done.

SOIL APPLICATION OF ZINC SULPHATE

Immediately after levelling, zinc sulphate @ 10 kg per acre and 15 kg per acre should be applied for the soil having pH range of 6.5-7.5 and above 8.5 respectively. To enhance the availability of zinc in soil, the zinc sulphate should be applied as enriched farmyard manure in 1:6 ratio. In addition, 500 g of slow release zinc-EDTA form should be applied as basal. At 25 days after planting, after weeding, 500 g of zinc-EDTA should be top dressed.

FOLIAR SPRAYING OF ZINC FORMS FOR THE TRANSPLANTED RICE CROP

Even after soil applications especially during December-January planting season, due to continuous water logging due to North West monsoon rains and water logging due to first season rice crop, zinc deficiency will be acute. Foliar sprays of zinc in the form of zinc sulphate (0.5%) or Zinc-EDTA (0.2%) should be done 15th days after planting and 25th days after planting.

CROP ROTATIONS

Crop rotations should be followed to maintain the zinc levels by allowing decomposition processes and also to prevent complete depletion. Short duration summer pulse crops like black gram, green gram should be sown with minimal tillage practices. Root nodules of black gram, green gram colonize beneficial microbes and they help to mobilize the unavailable form of zinc into their roots and vegetative parts. After maturity, threshing of seeds should be done from the harvested stalks. Vegetative portions and husks should be incorporated into the field by ploughing.

CULTIVATION OF ZINC DEFICIENT TOLERANT/ZINC RESPONSIVE RICE VARIETIES

Zinc deficient tolerant varieties such as IR36, IR42, ASD 16, TRY3 and Zinc responsive varieties like Improve white ponni, Paiyur 1, ADT43, CO 43, Bhavani should be cultivated to reduce or avoid the yield loss due to zinc deficiency.

CONCLUSION

Zinc deficiency is one of the major limiting factors that reduces the yield considerably and it needs to be alleviated for increasing productivity. Very few varieties have the ability to mobilize the unavailable form of zinc from deficient soil and use it for their growth and development. Their cultivation is limited to particular regions based on the adaptability and consumers preferences. Breeding rice varieties with zinc deficiency tolerance combined with regional preference for consumption should be the long term and sustainable goal in alleviating the zinc deficiency of rice for increasing productivity.

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