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# Validation and economic analysis of adaptable integrated management technology against root-knot nematode (*Meloidogyne graminicola*) in rice (*Oryza sativa*) with farmers' participatory approach

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ABSTRACT

Wider area validation and economic analysis of adaptable integrated root-knot nematode (*Meloidogyne graminicola*) management technology in rice (*Oryza sativa* L.) in farmers' participatory approach was carried out in adopted village Akkihebbalu, K.R.Pet, Mandya district, Karnataka during 2008, 2009 and 2010 in the 437 acre area covering 167 farmers' families. Integrated nematode management technology (INMT) for rice comprised raising rice nursery in cabrofuran (0.3g a.i/m$^2$) treated beds followed by its field application @ 1 kg ai/ha 40 days after transplanting ($T_1$) or applying *Pseudomonas fluorescence* @ 20 g/m$^2$ in soil nursery ($T_2$) or seed treatment of rice with *Trichoderma viride* @ 4 g/kg seed in nursery ($T_3$). The adoption of INMT resulted in reducing the nematode population from 320 $J_2$/200 c.c soil as initial nematode population to 135($T_1$) ,165 ($T_2$) and 192 ($T_3$)/200 cc of soil in the respective treatments thereby leading to increase yield 4.72 tonnes/ha, 4.67 tonnes/ha and 4.29 tonnes/ha in $T_1$,$T_2$ and $T_3$ respectively, in comparison to 3.81 tonnes/ha in untreated control ($T_4$).

**Key words:** Farmers' Participatory Approach, *Meloidogyne graminicola*, Nematode management, Rice, Root-knot nematode

India is the world's second largest producer of rice (*Oryza sativa* L.) accounting for 20% of all world rice production. Rice is India's dominant crop, and is the staple food of the people of the eastern and southern parts of the country but dynamics and severity of rice root-knot nematode problem in Karnataka has received attention of farmer's community. In India rice root-knot nematode (*Meloidogyne graminicola*) which used to be prevalent in certain pockets in West Bengal, Odisha, Asom and Kerala has been observed in rice-growing areas of eastern Uttar Pradesh, NCR Delhi, Haryana, Punjab, Himachal Pradesh, Tamil Nadu and Karnataka Etc (Sehgal *et al* 2000, Khan *et al.* 2004). The outbreak of *Meloidogyne graminicola* infestation in rainy (*kharif*) season rice has been witnessed in around 800 ha Mandya district of Karnataka (Parsad *et al.* 2001). The impact of *M. graminicola* on rice has been well established with yield losses up to 30%(ref). For effective management of rice-root knot nematode in one of the hot spot areas and validation of nematode management technologies developed by AICRP (Nematodes) was undertaken by NCIPM, New-Delhi in active collaborations with AICRP (Nematodes), AICRP (Rice) and State Department of Agriculture and Government of Karnataka.

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## MATERIALS AND METHODS

Three years trial on synthesis and validation of Integrated Nematode Management Technology in rice were carried out in a farmers' participatory approach in adopted village Akkihebbalu, K R Pet, Mandya district, Karnataka during 2008–10 in the 40 acre area covering 167 farmers' families. (The paddy nursery from each of the above mentioned treatments were transplanted separately in the main field and further observations on root-knot nematode disease incidence (galling and final nematode population) and yield (tonnes/ha) were recorded . Carbofuran treated nursery, transplanted in the field was further supplemented with another dosage of carbofuran @1.0Kg ai/ha (Furadan 3G@ 33kg/ha) 40 days after transplanting.) The Integrated Nematode Management technology (INMT) for rice included raising rice nursery using cabrofuran @ 0.3g ai/m$^2$ as nursery bed treatment

followed by its field application @ 1 kg ai/ha 40 DAT ($T_1$) or application of *Pseudomonas fluorescens* @ 20 g/m² in soil nursery ($T_2$) or seed treatment with *Trichoderma viride* @ 4 g/kg seed in nursery ($T_3$) as findings of AICRP (Nematodes). For each treatment 10 ha area was covered in each area. The observations were recorded on galling due to root-knot nematode at transplanting at harvest and yield. The nematodes were extracted by using modified Freckman *et al.* 1977 technique.

## RESULTS AND DISCUSSION

During 2008–10 it has been observed that carbofuran treated nursery beds had 15.66 galls/20 seedlings while *P. fluorescens* treated nursery beds had 17.41galls/20 seedlings. However, in untreated control 66.45 galls/20 seedlings were recorded. The nematode population was 135J2/200cc of soil in carbofuran treated bed, followed by 165J2/200cc of soil *P. fluorescens*, treated soil as compared to 320 J2/200cc soil in untreated control (Table1). At the harvest, galling as well as nematode population in carbofuran and *P. fluorescens* applied fields was significantly less in comparison to untreated control with substantial increase in rice yield (Table 2).

During 2008–10 the validation trial was conducted in the same village and population of root-knot nematode, *M. graminicola* and galling was less in carbofuran and *P. fluorescens*-treated fields. The same fields were continued for Integrated Nematode management technology with better nutrient management and adoption of recommended practices. During 2010–11 yield in carbofuran-treated plots was 4.72 tonnes/ha, while it was 4.68 tonnes/ha in *P. fluorescens*-treated plots. In untreated control 3.81tonnes/ha of paddy yield was recorded. During 2010–11, carbofuran-treated plots had 24.01% higher yield than any untreated nursery bed. In *P. fluorescens*-treated plots also registered 22.80% increase during 2010 as compared to the untreated bed followed by 12.83% increase in *T. viridae* seed, treated plots. In untreated control the yield was also increased to 8.73% in 2010–11 as compared to 2008, due to the adoption of proper cultivation practices and nutrient management in INMT fields by the farmers. The ICBR was 1:1.6 and 1:1.20 for carbofuran and *P. fluorescens*-treated fields respectively during 2010–11, while it was 1:1.11 and 1.121 for carbofuran and *P. fluorescens* plots respectively in 2008–09.

Initial popopulation was 540/200cc of soil.

Table 1 Severity of root knot nematode *M.graminicola* during nursery 2010–11

| | Treatment | Severity in Nursery | | |
|---|---|---|---|---|
| | | INP/200cc In Nursery | Final Nematode Population In Nursery/ 200cc of soil | Galls/20 seedlings |
| $T_1$ | Carbofuran Nursery+ 40DAT | 240 | 135 | 15.66 |
| $T_2$ | *P.fluroscences* -Nursery | 260 | 165 | 17.41 |
| $T_3$ | *T.viride*-seed treatment | 270 | 192 | 27.16 |
| $T_4$ | Untreated control | 230 | 320 | 66.45 |

Table 2 Growth parameters, pest severity and yield in IPM main field during 2010–11

| | Treatment | Main field | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | No. of tillers/ plant | Number of galls/20 plants | Plant height (cm) | No. of dried shoots due to stem borer/m² | Yield (g/m²) | Yield (tonnes/ha) | ICBR |
| $T_1$ | Carbofuran Nursery+ 40 DAT | 15 | 100 | 75 | 8.25 | 472.50 | 4.72 | 1:1.16 |
| $T_2$ | *P.fluroscences* -Nursery | 14 | 80 | 72.5 | 8.60 | 467.91 | 4.67 | 1:1.20 |
| $T_3$ | *T.viride*-seed treatment | 12 | 90 | 70.2 | 7.39 | 429.91 | 4.29 | 1:1.10 |
| $T_4$ | Untreated control | 12 | 440 | 68.0 | 18.00 | 381.00 | 3.81 | |

Table 3 Comparisons of yield data for 2008–09 and 2010–11

| | Treatment | Yield during 2008–09 (tonnes/ha) | Percentage decrease over untreated control | ICBR | Yield 2010–11 (tonnes/ha) | ICBR | Percentage increase over untreated control |
|---|---|---|---|---|---|---|---|
| T1 | Carbofuran Nursery + 40 DAT | 2.84 | 24.01 | 1:1.11 | 4.72 | 1:1.16 | 24.01 |
| T2 | *P.fluroscences* -Nursery | 2.89 | 26.33 | 1:1.21 | 4.67 | 1:1.20 | 22.80 |
| T3 | *T.viride*-seed treatment | | | | 4.29 | 1:1.10 | |
| T4 | Untreated control | 2.29 | | | 3.81 | | 12.83 |

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