*Research Paper :*

# Indigenous technology knowledge in the management of tobacco mosaic virus and enhancement of quality of bidi tobacco in India

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**SUMMARY**

**Tobacco Mosaic Virus (TMV) is the major stumbling block for successful cultivation of bidi tobacco in India and abroad. The present study was under taken during 2006 -07 and 2007-08 with ten different Indigenous Technology Knowledge(ITK) treatments along with plant extract sprayed on 25 and 50 day after transplanting. The main aim was to assess bioefficacy of these ITK measures in reducing TMV infection and influence on growth, yield and quality parameters. The pooled analysis over two years revealed that application of Viroson 2% (27.7 % Disease Incidence) followed by Bougainvillea leaf extract 5%(30.2% incidence) and neem 1500ppm(31.8%) incidence was effective. Among ITK measures, Panchagavya 5 %( 37.7%) followed by cow urine 10 % (37.8%) were effective. The untreated check recorded maximum incidence of 56.5 % incidence. There was no significant difference among the treatments with respect to growth parameters. However, better plant height, leaf length and leaf breadth were recorded in Viroson, Neem 1500ppm and Cow urine application indicating role induced systemic resistance. Maximum cured leaf yield (1206kg/ha) was recorded in cow urine 10% followed by Viroson 2 %( 1157 kg/ha). Among quality parameters, nicotine % ranged from 2.66 to 4.16 with maximum (4.16) in neem leaf extract followed by 3.77 % in Butter milk 5%.The reducing sugar ranged from 5.63 to 10.14% with maximum (10.14%) in Neem 1500ppm followed by 9.78% in Cow urine 10%. The chloride % was within the limit of <1 except butter milk (1.07%).Thus, the investigations opened a new window of opportunity in managing TMV infections through ITK measures enhancing both leaf yield and quality parameters in bidi tobacco.**

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Introduced in India by the Portuguese in 16th Century, tobacco cultivation has become a way of life as well as an industry and has made great strides. While playing a key role in Indian economy, despite its social disapproval due to its alleged association with human health, tobacco has thrived well. India occupies second place in area and third place in production accounting for 10% of world's area and about 9% of tobacco production by using just 0.3% arable land. India is one of the leading exporters of tobacco occupying fourth place in overall exports and ranks fifth in the export of FCV tobacco after Brazil, Zimbabwe, China and USA. The country accounts for about 5% (by volume) and 0.7% (by value) of world tobacco import export trade. It accounts for 4% (204 million US Dollars) of India's agricultural exports and 12% (Rs.8182 crores) of total excise revenue. Further, it is the livelihood of about 35 million people including 6 million farmers as well as others in direct or indirect manner (Anonymous, 2004). India produces about 700 million kg of tobacco in an area of 0.4 million ha.annually. Andhra Pradesh and Gujarat, Karnataka are the important tobacco growing states.

The tobacco environment has often provided ideal conditions for spread and multiplication of organisms that are later adapted as tobacco parasites. The diseases have become a major production constraint in tobacco cultivation both in Bidi and FCV tobacco. The loss due to these diseases is estimated to be in the range of 5 to 15 per cent depending on their intensity. The losses can be minimised by taking timely preventive and curative management practices. The foliar diseases even with low intensity can considerably reduce the value of the final produce in the market. The management practices developed should also consider the use of safer pesticides so as to avoid the residual problems. Tobacco mosaic virus (TMV) is the major stumbling block for successful cultivation of bidi tobacco in India

(Kulkarni *et al*.,2005). Identification of resistant sources against such systemic biotic infection is a challenging task for Plant Pathologists and Plant Breeders. All the ruling cultivars are highly susceptible for TMV and there are no alternate management strategies. Since,desuckering is done regularly in tobacco manually, it has become a major source for spread of the disease in the main field. In our previous studies, early stage infection has brought down the cured leaf yield by 20-25% and also affecting the quality of the produce. Farmers in India incur heavy monitory loss due to this disease. Hence, keeping these points in view to give a boost to existing popular cultivars for successful cultivation, the present study was under taken under field conditions.

## MATERIALS AND METHODS

The present investigations were taken up at Bidi Tobacco Research Station, Nipani during 2006-07 and 2007-08 for two years. The entire recommended package was followed for bidi tobacco cultivation. Each treatment was replicated thrice with plot size of 45sq.mt.The treatments in the form of spray were taken up at 25 and 50 days of transplanting. The first spray was taken up immediately after disease appearance coinciding with 25 days of planting, a stage for sucker initiation.

Ten treatments comprising of different indigenous technologies are as follows: $T_1$ : Vermiwash @10%, $T_2$: Panchagavya 10[1] 5%, $T_3$: Neem (azadirachtin) 1500 ppm 0.3%, $T_4$: Cow urine 10%, $T_5$:Butter milk 5%, $T_6$ : Neem leaf extract @ 5%, $T_7$:Bougainvillea leaf extract 5%, $T_8$:NPK (19:19:19) +Micronutrients spray, $T_9$: *Madhuca indica* 5% leaf extract, $T_{10}$: Viroson 0.2% and $T_{11}$: Untreated check.

The cow milk, curd, ghee, cow dung and cow urine have been used individually for curing many ailments as described in ancient text. It is known that cow ghee and curd contain certain living entities and antimicrobial substances. The Panchagavya is the product of five cow products such as milk, curd, ghee, dung and urine. In tradional Hindu family, it is also taken as Panchamratha in little quantity for purification both external and internal environmental of system. The innovative research on use of Modified Panchagavya Mixture (MPG-3) was carried out on three soil borne diseases like Fusarium wilt of tomato and banana, also foot rot of black pepper. The traditional Panchagavya was modified by adding yeast and common salt and three formulations were tested. The component MPG-3 was most effective in managing all these plant diseases which includes 2ml of ghee,5ml of curds,5ml of milk,40g dung and 48ml of urine mixed with 2g yeast and 2g salt for 100ml preparation (Shamarao, 1998). These components were mixed by adding one after the other in plastic container and kept for fermentation for seven to 10 days with closing of plastic container. The addition of salt is to reflect Jim Martin's living water promoting microbial activity which is further augmented with addition of yeast. The fermented preparation was diluted ten times with water and filtered through two layers of muslin cloth to obtain clear filtrate. The filtrate was used as spray solution in the present investigations.

Observations on per cent TMV infection, cured leaf yield were recorded and analysed stastically as per Sukhatme and Amble (1985). The quality parameters analysis on per cent nicotine content, % reducing sugars and % chlorides has been carried out at Quality Parameters Analysis Laboratory, Central Tobacco Research Institute, Rajahmundry.

## RESULTS AND DISCUSSION

Large number of botanicals were screened and ITK measures adopted in glass house against TMV infections on artificial inoculations. Based on the per se performance under glass house conditions, nine different treatments were selected for the field study. The results are presented from Table 1, 2 and 3. The main aim was to assess bioefficacy of these ITK measures in reducing TMV infection and influence on growth, yield and quality parameters.

During 2006,the minimum incidence of 19.9% after second spray was recorded in Bougainvillea leaf extract 5% followed by 25.3% in case of NPK + Micronutrients spray and Viroson. The maximum TMV infection was noticed in untreated control(46.1%).( Table 1).During 2007,the minimum TMV infection (30.2%) was noticed in Viroson@0.2% followed by Neem 1500ppm@000.3% (31.7%).The highest incidence of 66.8% was recorded in untreated control.

The pooled analysis revealed that application of Viroson @2% there was 27.7 per cent disease incidence followed by bougainvillea leaf extract 5%(30.2% incidence) and neem 1500ppm (31.8%) incidence (Table 1). Among ITK measures, Panchaghavya 5 % exhibited 37.7% PDI followed by cow urine 10% (37.8%) incidence. The untreated check recorded maximum incidence of 56.5 %. There was no significant difference among the treatments with respect to growth parameters. However, higher plant height, leaf length and leaf breadth were recorded in Viroson, Neem 1500ppm and cow urine application indicating role induced systemic resistance.

There was no significant difference with respect to cured leaf yield for the years of experimentation and over pooled analysis (Table 2). However, the pooled analysis

**Table 1 : Management of tobacco mosaic virus through organic**

| Tr. No. | Treatment details | Incidence 20 days after I$^{st}$ spray | | | Incidence 10 days after II$^{nd}$ spray | | |
|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | Pooled | 2006 | 2007 | Pooled |
| $T_1$ | Vermivash @10% | 35.1 (36.3) | 36.8 (37.35)* | 35.9 | 33.9 (35.61) | 42.9 (40.92)* | 38.4 |
| $T_2$ | Panchaghavya @5% | 36.4 (37.1) | 42.4 (40.63) | 39.4 | 35.5 (36.57) | 39.9 (39.17) | 37.7 |
| $T_3$ | Neem 1500 ppm@0.3% | 32.8 (34.9) | 51.9 (46.09) | 42.3 | 32.0 (34.45) | 31.7 (34.27) | 31.8 |
| $T_4$ | Cow urine@10 % | 32.2 (34.6) | 47.3 (43.45) | 39.7 | 32.6 (34.82) | 43.0 (40.98) | 37.8 |
| $T_5$ | Buttermilk @5 % | 28.1 (32.0) | 42.6 (40.74) | 35.4 | 33.7 (35.49) | 53.1 (46.78) | 43.4 |
| $T_6$ | Neem leaf extract @5% | 30.9 (33.7) | 38.2 (38.17) | 34.6 | 32.4 (34.70) | 46.5 (42.99) | 39.5 |
| $T_7$ | Bougainvillea leaf extract@5% | 22.8 (28.5) | 42.3 (40.57) | 32.6 | 19.9 (25.49) | 40.5 (39.52) | 30.2 |
| $T_8$ | NPK +micronutrient | 26.6 (31.0) | 47.4 (43.51) | 37.0 | 25.3 (30.20) | 43.1 (41.03) | 34.2 |
| $T_9$ | Viroson@0.2% | 22.1 (28.0) | 30.6 (33.58) | 30.1 | 25.3 (30.20) | 30.2 (33.34) | 27.7 |
| $T_{10}$ | Control | 38.1 (38.1) | 67.8 (53.61) | 52.9 | 46.1 (42.76) | 66.8 (54.82) | 56.5 |
| | S.E.± | 2.81 | 2.87 | 2.29 | 2.02 | 3.63 | 2.35 |
| | C.D. (P=0.05) | 8.29 | 8.55 | NS | 6.51 | 10.7 | 7.50 |
| | C.V. % | 16.15 | 11.94 | 8.64 | 12.34 | 14.95 | 8.79 |

revealed that the maximum cured leaf yield of 1206 kg/ha in cow urine 10% followed by Viroson 2%(1157 kg/ha).

Among quality parameters, nicotine % ranged from 2.66 to 4.16 with maximum (4.16) in neem leaf extract followed by 3.77 % in Butter milk 5%. The reducing sugars ranged from 5.63 to 10.14% with maximum (10.14%) in Neem 1500ppm followed by 9.78% in cow urine 10%. The chloride % was within the limit of <1 except butter milk (1.07%).The analysis of quality parameters indicated better quality tobacco with better flavour due to increased levels of reducing sugars in organic treatments. These organics play an important elicitors inducing systemic resistance in tobacco. The successful management of panama disease of banana caused by *Fusarium oxysporum* f. sp. c*ubense*, foot rot of black pepper, Fusarium wilt of tomato by use of neem based products and ITK measures has earlier been reported (Shamarao, 1998; Shamarao *et al*., 2000; 2003; Holly and Steve, 2005). In case of Panama disease of banana, working with Panchagyvya (MPG-3) at $10^1$ dilution along with different bioagents like *Trochoderma viride* (0.25%), *Pseudomonas fluorescens* (1 hr dip,$10^8$ cells/ml), *Bacillus subtilis* (1 hr dip,$10^6$ cells/ml) has been found effective. The MPG-3 gave better influence on plant height, number of leaves, maximum root length and pseudo stem girth etc. There was reduction in Fusarium population in MPG-3 providing encouraging results compared with seedling

**Table 2 : Management of TMV through organic**

| Tr. No. | Treatment details | Cured leaf yield (kg/ha) | | |
|---|---|---|---|---|
| | | 2006 | 2007 | Pooled |
| $T_1$ | Vermivash @10% | 958 | 1078 | 1018 |
| $T_2$ | Panchaghavya @5% | 1000 | 1117 | 1058 |
| $T_3$ | Neem 1500 ppm @ 0.3% | 850 | 1188 | 1019 |
| $T_4$ | Cow urine@10 % | 900 | 1512 | 1206 |
| $T_5$ | Buttermilk @5 % | 717 | 1269 | 993 |
| $T_6$ | Neem leaf extract @ 5% | 550 | 1387 | 968 |
| $T_7$ | Bougainvillea leaf extract @5% | 500 | 1274 | 887 |
| $T_8$ | NPK +micronutrient | 483 | 1272 | 877 |
| $T_9$ | Viroson | 1050 | 1264 | 1157 |
| $T_{10}$ | Control | 900 | 1258 | 1079 |
| | S.E.± | 167.3 | 140.68 | 139.28 |
| | C.D. (P=0.05) | NS | NS | NS |
| | C.V. % | 29.20 | 19.24 | 19.19 |

NS-Non significant

**Table 3: Influence of different treatments on quality parameters**

| Tr. No. | Treatment details | Nicotine % | Reducing sugars % | Chlorides % |
|---|---|---|---|---|
| $T_1$ | Vermivash @10% | 3.58 | 7.90 | 0.34 |
| $T_2$ | Panchaghavya @5% | 3.34 | 7.44 | 0.52 |
| $T_3$ | Neem @1500 ppm | 2.64 | 10.14 | 0.74 |
| $T_4$ | Cow urine@10 % | 3.28 | 9.78 | 0.66 |
| $T_5$ | Buttermilk @5 % | 3.77 | 8.55 | 1.07 |
| $T_6$ | Neem leaf extract @5% | 4.16 | 5.63 | 0.69 |
| $T_7$ | Bougainvillea leaf extract @5% | 3.16 | 9.60 | 0.57 |
| $T_8$ | NPK +micronutrient@2.5ml/lit | 3.22 | 8.32 | 0.38 |
| $T_9$ | *Madhuca indica* @5% | 3.67 | 9.00 | 0.51 |
| $T_{10}$ | Viroson@2ml/lit | 2.66 | 8.55 | 0.79 |
| $T_{11}$ | Control | 3.21 | 9.20 | 0.35 |

dip. The population of *Fusarium oxysporum* f.sp.*cubense* declined significantly to $11.8x10^4$ cfu/g after 150 days of planting. These results indicate the promise shown by MPG-3 in eco-friendly and cost effective management of Fusarium wilt (Shamarao, 1998, Shamarao *et al*., 2000).

Developed and standardized effective IDM package: Soil application of *T.viride* (75g/pt) +spraying with metalaxyl (1.25g/lt) +Akomin (4ml/lt) or MPG 3 ($10^1$) has been found effective for the management of foot rot of black pepper (Shamarao, 1998, Shamarao *et al.*, 2000). The research work carried out at UAS, Bangalore clearly demonstrated the role of MPG-3 as PGPR component and ISR activity against Fusarium wilt of tomato (Baskar, 1994).

At present work is being done on mechanism of resistance by these organics leading to Induced Systemic Resistance in tobacco against TMV and looking for activation defense genes either by salicylic acid or jasmonic acid pathways. The out come will be the first ever report on understanding the mechanism of action of ITK measures in managing TMV.

## Conclusions:

The botanical and ITK elicitors like Viroson, Bougainvillea leaf extract,Panchgavya and Cow urine be used in developing Integrated Disease Management strategies against TMV in India which will help in reducing the loss caused by this disease in long term sustainable management. The present findings have drawn the first line of research on utilization of Indigenous Technology Knowledge in managing TMV and enhancing both yield and quality parameters of tobacco in India.

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