**Field evaluation of maize banded leaf and sheath blight disease by using botanicals and cow based natural products**

**ABSTRACT**

 Maize is one of the most important food crops in the world. In India, it is the third most significant cereal crop after rice and wheat, cultivated across diverse environmental conditions. Among the major diseases affecting maize, banded leaf and sheath blight (BLSB) is one of the most destructive soil-borne diseases, caused by *Rhizoctonia solani* f.sp. *sasakii.* Use of chemicals may give rise to undesirable biological effects on animals and human beings therefore ecofriendly management practices for better crop health management and yield.The present studies were undertaken to work out the efficacy of botanicals and cow based natural products (CBNP) along with one positive control (propiconazole @ 0.1%) for the management of BLSB under field condition for two seasons *rabi* 2018-19 and 2019-20. Analysis revealed that Karanj leaf extract @ 15%+Panchagavya @ 5%, Propiconazole @ 0.1% , T3-Panchagavya @ 5% and Karanj leaf extract @ 15% were found effective against BLSB. The identified sources can be used further in strengthening the plant protection in maize against BLSB.

 ***Keywords:***Banded leaf and sheath blight, Botanicals, Cow based natural products, Efficacy

 **INTRODUCTION**

 Maize (*Zea mays* L.) is the world’s leading crop and is widely cultivated as a cereal grain. It is the most versatile emerging crops having wider adaptability. Maize is one of the food cereal crop that can be raised in diverse ecological conditions. Apart from this, maize is a chief industrial raw material and provides great opportunity for value addition.

*Rhizoctonia solani* f.sp. *sasakii,* the causal agent of maize banded leaf and sheath blight (BLSB) disease, is the most destructive soil borne pathogen, causes a maximum of 60% yield loss under natural conditions (Tang *et al.,* 2004) and it predominantly spread through irrigation water. The maize crop is prone to BLSB during high humid conditions coupled with optimum temperature and rainfall. Such, conducive environment favour the pathogen to multiply resulting in maximum damage to the crop, with considerable yield loss.

Disease management through synthetic chemicals might have resulted in several adverse effects, *i.e.* residual toxicity, resistance development in pathogen, environmental pollution, carcinogenic risks on animals and human beings (Brent and Hollomon, 1998; Schillberg*et.al*., 2001). With the increase of interest in antibiotics, plants as a source of potential antimicrobial substances are receiving considerable attention throughout the world (Osman and Abdulrahman, 2003).Tamuli et al. (2014) reported antifungal activity of plant extracts to be effective than commercial synthetic fungicides due to presence of naturally occurring anti-microbial property that have been recognized and tested against a wide range of pathogenic microbes. The antifungal activity of panchagavya against major soil borne pathogens were studied, and 100 per cent inhibition in *R. solani, S. rolfsii*and*S. Sclerotiorum* reported (Kumar *et al*., 2020). Extracts prepared in cow urine were found significantly more efficacious in arresting the mycelial growth as well as in checking the disease severity compared to cold water and hot water extracts and were at par with hexaconazole (Tiwari and Das, 2011). Reports by Lal *et al.* revealed that the maximum banded leaf and sheath blight (BLSB) disease control was observed with spray of propiconazole (72.2%) followed by validamycine (62.2%), hexaconazole (51.0%) under field conditions. Venkateswarlu and Beura (2020) reported a maximum inhibition of *Rhizoctonia solani* f .sp. *sasakii*, mycelium growth was observed in Difenoconazole (99.98%) and Hexaconazole (99.96%).

Therefore, in the present study some locally available plants and cow based natural products were tested to examine their efficacy for effective management against *Rhizoctonia solani* f.sp. *sasakii*.

**MATERIAL AND METHODS**

 The present study was conducted at the Agricultural College Farm, Bapatla, Guntur district, Andhra Pradesh, during the year 2019 and 2020*rabi,* two leaf extracts (Karanj @ 15% and Nerium @ 5%), two cow based natural products (Panchagavya @ 5% and Cow urine @10%) and their combinationswere tested against BLSB on variety, Poineer 3396 under field conditions with common spacing of 60cm x 20cm.

 Fresh tender leaves of both Karanj and Nerium (100 g) were washed under running tap water followed by sterile distilled water and blot dried. Leaf tissues were macerated with 100 ml of sterile distilled water (1:1) and filtered through double layered sterile muslin cloth to collect leaf extracts. It was centrifuged at 5000 rpm for 10 min to get clear supernatant which was further sterilized through G-3 filter. The resultant extracts were considered as standard leaf extract solution with 100% concentration (Kurucheve *et al.,* 1997). Panchagavya and cow urine were procured from the local Zero Budget Natural Farming (ZBNF) farmer and were filtered through Whatman No. 1 filter paper and filter sterilized with G-3 filter. Freshly prepared solutions were used for *in vivo* studies.

A standard fungicide Propiconazole @0.1% was used for comparison along with control (water only). In total, there were 10 treatmentsand 3 replications. Artificial toothpick inoculation was done at 35 days old crop during morning hours. Pure culture of virulent *Rhizoctonia solani* f.sp. *sasakii* isolate was multiplied on barley grains. Three barley grains coated with fungal growth were placed using toothpick between stalk and leaf sheath of each plant at second and third internodes from soil followed by irrigation to maintain humid conditions (Shekhar and Kumar, 2012). Treatment sprays were given twice at 15 day interval with the first spray initiated at the time of disease appearance. Disease severity of BLSB was assessed on the day before spraying (42 DAS), 7 days, 14 days after each spraying and Per cent disease index (PDI) was calculated based on disease severity data from the formula given by Wheeler (1969).

 Sum of individual disease ratings

 PDI = ----------------------------------------------------------------------- X 100

 No. of observations assessed X maximum disease rating

The efficacy of different treatments was assessed based on Area Under Disease Progress Curve (AUDPC) values using the formula given by Wilcoxson *et al*. (1975).

$$AUDPC=\sum\_{i=1}^{k}\frac{1}{2}\left(S\_{i}+S\_{i-1}\right)×d$$

Where,

*Si*= Disease incidence at ith day of evaluation

*k*  =Number of successive evaluation of the disease

d = Interval between i and i-1 evaluation of disease

**RESULTS AND DISCUSSION**

Results indicate that all the treatments assessed were found effective against BLSB in comparision to control in both the testing years (2019 and 2020) during *rabi* season are presented in table 1. Pooled data (*rabi* 2019-20) also indicated that all the treatments showed similar pattern of efficacy against BLSBas observed in individual seasons.

Treatment T5-Karanj leaf extract @ 15%+Panchagavya @ 5% was found effective among all treatments showing the lowest PDI (35.77%) as compared to control (62.96%). However, T9-Propiconazole used as fungicide check @0.1% was found effective with PDI (37.37%) followed by T3-Panchagavya @ 5% with PDI (37.77%). Among all the treatments maximum inhibition over control was recorded in treatment T5-Karanj leaf extract @ 15%+Panchagavya @ 5% (43.18%) followed by T9-Propiconazole @ 0.1% (40.64%) and T3-Panchagavya @ 5% (40.00%) while least inhibition over control was observed in T2-Neriumleaf extract @ 5% (12.33%) (Table 1).

Reduction in banded leaf and sheath blight disease resulted in increase in the amount of yield. Maximum yield @ 7469.14 Kg ha-1 with 90.56% increase over control was recorded in T5-Karanj leaf extract @ 15%+Panchagavya @ 5%recorded with highest test weight (22.83 g) was on par withT9-Propiconazole @ 0.1% @ 7221.04 Kg ha-1 with 84.02% increase over control with a test weight of 22.33g (Table 2 and Fig.1).

AUDPC was estimated for all the imposed treatments during *rabi,* 2019 and 2020. Treatment Karanj leaf extract @ 15%+Panchagavya @ 5% was recorded with lowest AUDPC of 670.60against the control (1137.16) and also proved its superiority among the tested treatments. Maximum AUDPC (990.15) was observed with Nerium leaf extract @ 5%. (Table 3)

Reports by Karthika *et al.* (2017) revealed that panchagavya @ 5% resulted in 100% inhibition of mycelial growth of *R. solani.* Sharma *et al*. (2018) reportedthat maximum per cent growth inhibition of *R. solani* occurred with extract of garlic cloves (71.85%) followed by leaf extract of Karanj (38.88%). Sehajpal *et al.* (2009) explored the fungicidal efficacy of 44 plant extracts including eight oils against *R. solani* reported that thirty-six plant extracts were described with fungi toxic potentiality against *R. solani*. Prasad *et al.,* (2020) found that Karanj oil very effective in inhibiting the growth of *R. solani* at 10 % concentration. Pongamia leaf extract at 5, 10 and 15 per cent concentration was found to be effective against root rot pathogen, *R. solani* under *invitro* conditions (Naik *et al*. 2016). Gunasri *et al.* (2020) reported that maximum mycelia growth inhibition of *R. solani* f.sp. *sasakii* was observed with Karanj leaf extract @ 15% (64.66%) and 10% (54.22%).

**Table 1. Efficacy of leaf extracts and cow based natural products and their combinationsagainst maize banded leaf and sheath blight disease *in vivo***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Foliar spray** | **Rabi 2019** | **Rabi 2020** | **Rabi 2019 & 2020 (Pooled)** |
| **PDI** | **Inhibition over control (%)** | **PDI** | **Inhibition over control (%)** | **Pooled****PDI** | **Inhibition over control (%)** |
| T1 | Karanj leaf extract @ 15% | 38.74(38.47)abc | 36.53 | 39.11(38.69)a | 39.71 | 38.92 (38.58)ab | 38.18 |
| T2 | Nerium leaf extract @ 5% | 48.11(43.89)d | 19.00 | 56.88(48.94)b | 12.33 | 52.50 (46.41)c | 16.61 |
| T3 | Panchagavya @ 5% | 37.33(37.64)ab | 38.84 | 38.22(38.17)a | 41.09 | 37.77 (37.91)a | 40.00 |
| T4 | Cow urine @ 10% | 45.77(42.55)cd | 25.01 | 51.11(45.62)b | 21.22 | 48.44 (44.09)c | 23.06 |
| T5 | T1+ T3 | 34.81(36.14)a | 42.97 | 36.74(37.29)a | 43.37 | 35.77 (36.72)a | 43.18 |
| T6 | T1+T4 | 46.66(43.07)cd | 23.55 | 52.89(46.64)b | 18.48 | 49.78 (44.85)b | 20.93 |
| T7 | T2+T3 | 43.85(41.44)bcd | 28.16 | 42.52(40.67)a | 34.46 | 43.18 (41.06)b | 31.41 |
| T8 | T2+T4 | 47.55(43.58)d | 22.10 | 54.67(47.68)b | 15.73 | 51.11 (45.62)c | 18.83 |
| T9 | Propiconazole @ 0.1% (Fungicide Check) | 36.96(37.41)ab | 39.44 | 37.78(37.91)a | 41.76 | 37.37 (37.67)a | 40.64 |
| T10 | Control | 61.04(51.41)e | ---- | 64.88(53.64)c | ---- | 62.96 (52.50)d | ---- |
| SEm± | 1.48 |  | 1.37 |  | 0.96 |  |
| CD (P ≤ 0.05) | 4.39 |  | 4.08 |  | 2.84 |  |
| CV (%) | 6.16 |  | 5.46 |  | 3.90 |  |

\*Figures in parenthesis are arc sine transformed values ;\*Values with the same alphabets are statistically not significant

**Table 2. Efficacy of leaf extracts and cow based natural products and their combinations against maize banded leaf and sheath blight disease *in vivo***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Foliar spray** | **Rabi 2019** | **Rabi 2020** | **Rabi 2019 & 2020****Pooled data** |
| **Test weight** |  **Yield****(kg ha-1)** | **Inhibition over control (%)** |  **Test**  **weight** |  **Yield****(kg ha-1)** | **Inhibition over control**  **(%)** | **Test weight** | **Yield****(kg ha-1)** | **Inhibition over control (%)** |
| T1 | Karanj leaf extract @ 15% | 21.43ab | 6915.95b | 70.05 | 21.33a | 6061.25cb | 60.26 | 21.38ab | 6488.60b | 65.33 |
| T2 | Nerium leaf extract @ 5% | 15.95c | 5026.11d | 23.64 | 14.95b | 4432.57f | 17.13 | 15.45c | 4729.34e | 20.50 |
| T3 | Panchagavya @ 5% | 21.80ab | 6965.81b | 71.27 | 21.38a | 6301.04b | 66.66 | 21.59ab | 6633.43b | 68.96 |
| T4 | Cow urine @ 10% | 20.65b | 6111.11c | 50.26 | 20.98a | 5296.77ed | 40.11 | 20.82ab | 5703.94c | 45.37 |
| T5 | T1+ T3 | 23.17a | 7801.51a | 91.76 | 22.48a | 7136.75a | 89.26 | 22.83a | 7469.14a | 90.56 |
| T6 | T1+T4 | 20.51b | 5517.56d | 35.72 | 20.20a | 4962.01ef | 31.26 | 20.36b | 5239.79d | 33.57 |
| T7 | T2+T3 | 21.23ab | 6225.07c | 53.06 | 21.19a | 5562.67dc | 47.08 | 21.21ab | 5893.87c | 50.27 |
| T8 | T2+T4 | 16.46c | 5254.03d | 29.24 | 16.03b | 4610.63f | 21.84 | 16.25c | 4932.34de | 25.77 |
| T9 | Propiconazole @ 0.1% (Fungicide Check) | 22.57ab | 7552.23a | 85.63 | 22.09a | 6889.83a | 82.10 | 22.33ab | 7221.04a | 84.02 |
| T10 | Control | 13.04d | 4069.32e | --- | 12.08c | 3784.42g | --- | 12.56d | 3926.88f | ---- |
| SEm± | 0.66 | 184.47 |  | 0.85 | 188.45 |  | 0.71 | 152.50 |  |
| CD (P ≤ 0.05) | 1.97 | 548.10 |  | 2.55 | 266.51 |  | 2.11 | 453.12 |  |
| CV (%) | 5.85 | 5.20 |  | 7.71 | 5.93 |  | 6.33 | 4.53 |  |

\*Values with the same alphabets are statistically not significant.

**Table 3. AUDPC for *in vivo* management of maize banded leaf and sheath blight**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Foliar spray** | **AUDPC 2019** | **AUDPC 2020** | **AUDPC 2019&20 (pooled)** |
| T1 | Karanj leaf extract @ 15% | 678.33 | 769.93 | 724.13 |
| T2 | Nerium leaf extract @ 5% | 866.70 | 1113.60 | 990.15 |
| T3 | Panchagavya @ 5% | 657.37 | 762.12 | 709.75 |
| T4 | Cow urine @ 10% | 787.57 | 1021.90 | 904.74 |
| T5 | T1+ T3 | 631.92 | 709.27 | 670.60 |
| T6 | T1+T4 | 804.12 | 1046.85 | 925.49 |
| T7 | T2+T3 | 764.78 | 931.31 | 848.05 |
| T8 | T2+T4 | 846.12 | 1063.90 | 955.01 |
| T9 | Propiconazole @ 0.1% (Fungicide Check) | 656.56 | 729.43 | 693.00 |
| T10 | Control | 1016.23 | 1258.08 | 1137.16 |

 **Fig. 1 Efficacy of leaf extracts and cow based natural products and their combinations against**

 **maize banded leaf and sheath blight disease during *in vivo rabi* 2019, 2020 and 2019- 20**

 **(pooled)**

**CONCLUSION**

In the present investigation, among all the treatments maximum yield @ 7469.14 Kg ha-1 with 90.56% increase over control was recorded in T5-Karanj leaf extract @ 15%+Panchagavya @ 5% with low disease severity (35.77%). Therefore use of plant extracts and cow based natural products CBNP as a means of ECO-FRIENDLY management practices is found crucial and effective towards management of maize banded leaf and sheath blight.

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