



# Field Bioefficacy of Wood vinegar on productivity of Paddy

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## Abstract

An organic based botanical source wood vinegar was screened for its efficacy to improve paddy crop yield under ex-situ condition. A field experiment was executed to evaluate the field efficacy of wood vinegar on paddy with respect to yield improvement, pest and disease control. A paddy was selected in alanganallur village of Madurai district during 2022-2023. Wood vinegar as various doses viz 5ml, 10ml, 15ml and 20ml per litre of water was considered for executing in paddy crops by which the growth observation, pest and disease incidence reduction were carried out. Among various concentrations of wood vinegar tested, 15ml per litre treated paddy plants showed satisfactory results in productivity and minimized level of thrips and rice blast infestation.

Keywords: Field Efficacy, Wood vinegar, Yield Improvement, Pest and Disease control, Paddy.

## Introduction:

Wood vinegar is one of the organic sources and often referred to pyroligneous acid or wood acid. While a variety of biomass types can be used to produce wood vinegar, such as wood, Crops, Agricultural residues or different Wood vinegar is formed by the condensation of smoke produced during the production of biochar. It of soil quality, eliminates of plant and soil pests, controls plant growth, is able to accelerate the development of roots, stems, tubers, leaves, flowers, and fruits, and, increases amounts of fruit produced in orchards. According to Brunette, R. (2010), wood vinegar is mainly contains Acetic acid, Butyric acid, Catechol and Phenol. Wood vinegar has a compound effect of promoting crop growth similar to plant growth regulators and is environmental friendly.

Wood vinegar is having property of excellent pesticide and fertilizer that improves soil quality, helps elimination of pests and assists in the plant growth control by being able to accelerate the development of plants. It is often used to increase the amounts of fruits produced in orchards. As commonly known, chemical fertilizers which are usually utilized in the agricultural industry can cause the soil being sprayed to be too acidic and leads to another problem in the environment; water pollution. Wood vinegar is the substance produced through the condensation of smoke emitted during the pyrolysis of wood and its residues from processing. It is an essential substance that promotes healthy method for propagating plants, and also, it can be used as fertilizer or soil conditioner. Several researches have already evidenced the great impact of using wood vinegar for elevating the nutrient level of soil. According to Payamara, J. (2011), the major component of wood vinegar products is acetic acid, methanol, propanoic acid, phenolic and carbonyl compounds.

The wood vinegar improves soil quantity eliminates pests, accelerating plant growth, plant growth regulator or growth inhabiting. The bio-test of wood vinegar inhibits the growth of *Xanthomonas comprestri* spv. The wood vinegar was applied on maize with spraying on leaf compare with spraying on soils every 6 days after planting. The acidity range 1.95 to 2.14 the major component in wood vinegar was observed to be acetic acid. According to Thailand's Department of Agriculture (2010), wood vinegar can improvement produced when smoke from

charcoal production is cooled by outside air while passing through a chimney or flue pipe. The cooling effect causes condensation of pyroligneous liquor, particularly when the temperature of smoke produced by carbonization ranges between 80 and 180°C/176 and 356°F (Nikhom, 2010). This temperature is reached at the carbonization stage of exothermic decomposition (see previous article about charcoal production) and is indicated by the production of yellowish, acrid smoke. Moreover, Tancho, A. reported that wood vinegar can be applied to the soil surface to help increase the population of beneficial microbes and to promote plant root growth. Additionally, the product can help boost crop defenses against disease. A strong solution of wood vinegar with a 1:30 ratio application to the garden soil surface at a rate of 6 liters of solution per 1m<sup>2</sup> will enrich the soil prior to planting crops. Also, it can be used to control soil-based plant pathogens with an even stronger rate of 1:5 to 1:10 ratio. This prompted the researchers to further add literature and studies to the growing interest of the scientific community in utilizing the many uses of wood vinegar in the agricultural sector, to further prove the best exploit of wood vinegar in backyard soil to further determine if the application of wood vinegar for agriculture is reasonable.

Due to the rapid population growth, agricultural lands have been used extensively to meet the nutritional and shelter needs of the people recently, resulting in soil exhaustion and soil pollution. The technological developments affect the agricultural sectors in the world as well. For this reason, developed countries has started to perform natural and different applications in order to ensure the sustainability of agricultural production areas, to reduce soil pollution, to restore the flora and fauna of agricultural soils, and to improve soil chemistry. One of these applications is the use of wood vinegar. However, in Turkey as the agriculture is not considered as an industry, synthetic production inputs are uncontrolledly used and also a very intensive agricultural production is carried out without considering the consequences of negative processing techniques and technologies, just like in the developed countries of the world (Tarhan, 2005).

Wood vinegar is a byproduct from the charcoal production process (Fengel and Wegener, 1984). It contains more than 200 chemicals including wood vinegar, acetic acid, methanol, phenol, ester, acetal, ketone, formic acid and many other organic chemicals (Mu *et al.*, 2003; Kadota and Nimii, 2004). Wood vinegar consists mainly of water soluble compounds, over 200 kinds. Its main ingredients are organic. Acetic acid acids, phenolics, alkanes, alcohol and ester compounds are its main components. There are many uses for wood vinegar in the agriculture (Jothityangkoonet *al.*, 2007). Wood vinegar when used as foliar fertilizer enhances yields in cucumber, lettuce and cole (Mu *et al.*, 2006; Jothityangkoonet *al.*, 2007). Mixing charcoal and wood vinegar in planting materials improves growth, branching and survival rate of Zinnia and increases yield of it (Kadota and Niimi, 2004).

## MATERIALS AND METHODS

### *Field preparation:*

We selected 20 cent plot of paddy field for conducting experiment. We divided that plot into five plots, A single plot carried 2 cents (200 plants). We named that plots into Plot A, Plot B, Plot C, Plot D, Plot E.

### *Treatment details:*

Various concentrations of wood vinegar were taken for this study and they were evaluated at 5ml/ L, 10ml/ L, 15 ml/ L And 20ml/ L of water as four different dosages in paddy field for its efficacy on yield, disease and pest control.

- Plot A - 5 ml of wood vinegar/ 1L of water
- Plot B - 10 ml of wood vinegar/ 1 L of water
- Plot C - 15 ml of wood vinegar/ 1 L of water
- Plot D- 20 ml of wood vinegar/ 1 L of water
- Plot E- Untreated control.

### *Wood vinegar details:*

The commercial grade of wood vinegar was procured from ASPIRE RENOIL ASSOCIATES Co., 4 /123 -A MuthugounderThottam, Pappampatti, Coimbatore – 641 016, Tamil Nadu. Composition of wood vinegar given in the table 1.

#### *Field and crop details:*

Field experiment was conducted in paddy planting area located in Vavidamaruthur taluk, Alanganallur village, Madurai district, Tamil nadu (Latitude :10.039509°, Longitude :78.114151°). Experiment was performed on the paddy area which is poor in yield to improve yield.

The variety of the paddy crop is Co 51. The source of irrigation is taken from Alanganallur dam by channel irrigation.

#### *pH measurement:*

The commercial formulation wood vinegar was taken and diluted with 100 ml of water in different concentrations (0.5ml/100ml, 1ml/100ml, 1.5ml/100ml, 2ml/100ml) and measured the pH using the pH meter. After measurement the different concentrated of wood vinegar was thoroughly drenched over the plants. After one hour of the spraying, the treated soil was collected and measured the pH and the values were tabulated.

#### *Wood vinegar as pesticide:*

Wood vinegar is an organic material derived from wood waste that can be used as a plant-based insecticide. The objectives of this study are to determine the percentage of thrips attacks on paddy plants and the application of plant-based insecticides on paddy plants towards thrips attacks reduction Wood vinegar used in this study was dissolved in water as per the treatment doses. Solution of wood vinegar with a concentration of was applied on all parts of the paddy plants.

After two rounds of application keeping 10 days interval, the field was monitored for insect attack. Based on observations in the field, the symptoms observed on paddy plants that attacked (Morina Adfaet *al.*,2017).

#### *Wood vinegar as fungicide:*

Wood vinegar is an organic material derived from wood waste that can be used as a plant-based fungicide. The objectives of this study are to determine the percentage of rice blast disease on paddy plants and the application of plant-based fungicides on paddy plants towards rice blast disease reduction Wood vinegar used in this study was dissolved in water as per the treatment doses. Solution of wood vinegar with a concentration of was applied on all parts of the paddy plants.

After three rounds of application keeping 7 days interval, the field was monitored for rice blast disease. Based on observations in the field, the symptoms observed on paddy plants that attacked (DaruneeJothityangkoon *et al.* 2015).

## **RESULTS AND DISCUSSION**

Improvement of yield and also pest and disease control are important for agriculture. It is useful for farmers to improving their economic value. In our experiment the Treatment 3 (15ml/ L) Plot C is giving good results in yield, pest and diseases. Observation of biometric parameters of paddy crop treated with various doses of wood vinegar were carried out and tabulated after imposing the treatments).

#### *Observation:*

We observed the growth parameter of the plants in paddy field. The parameters like plantlets per bunch, height of the plant, Number of leaves, width of leaf, fresh weight, dry weight, weight of seed (100) & weight of the total seed.

First application of wood vinegar was given on thirty days old paddy plants. Totally five rounds of application was implemented keeping 7 days interval. The plants were uprooted after two months from fifth spraying of wood vinegar and respective biometric parameters were noted and tabulated (Figure 1, 2, 3).

#### *pH measurement:*

The commercial formulation wood vinegar was taken and diluted. After one hour of the spraying, the treated soil was collected and measured the pH and the values were tabulated.

The raw wood vinegar pH was 3.69, the pH of the wood vinegar on concentration of 0.5ml was 6.27, the pH of the wood vinegar on the concentration of 1ml was 5.10, the pH of the wood vinegar on the concentration of 1.5ml was 4.85 and the pH of the wood vinegar the concentration of 2ml was 4.66. When wood vinegar was diluted in water, the pH of the suspension was decreased from lower concentration to higher concentrations (Table 1).

The pH of the soil after spraying the wood vinegar on the concentration of 0.5ml was 7.62, The pH of the soil after spraying the wood vinegar on the concentration of 1ml was 7.42, The pH of the soil after spraying the wood vinegar on the concentration of 1.5ml was 7.75, The pH of the soil after spraying the wood vinegar on the concentration of 2ml was 7.93 and the untreated control soils pH was 7.34. The incorporation of wood vinegar in soil via drenching the plants, all the samples pH was become nearly neutral (Table 2).

#### *Wood vinegar use for yield improvement:*

##### *Effect of wood vinegar at 5 ml / litre on biometric values of paddy:*

Wood vinegar was sprayed at the first treatment of 5ml of wood vinegar per litre was gave the yield of 105.4 g seeds for five bunches, the plantlet per bunch was 9(optimum), the average height of plants was 71cm, the average fresh weight of the bunch was 67.7g (Table 3).

##### *Effect of wood vinegar at 10 ml / litre on biometric values of paddy:*

The second treatment of 10ml of wood vinegar per litre was gave the yield of 118.5 g seeds for five bunches, the plantlet per bunch were 11(optimum), the average height of the plant was 78cm, the average fresh weight of the bunch was 64.2g (Table 4).

##### *Effect of wood vinegar at 15 ml / litre on biometric values of paddy:*

The third treatment of 15ml of wood vinegar per litre was gave the yield of 148.2 g of seeds for five bunches, the plantlet per bunch was 13(optimum), the average height of plants was 81cm, the average fresh weight of the bunch was 84.8g (Table 5).

##### *Effect of wood vinegar at 20 ml / litre on biometric values of paddy:*

The fourth treatment of 20 ml per litre was gave the yield of 192.1 g of seeds for five bunches, the plantlet per bunch was 11(optimum), the average height of plants was 78cm, the average fresh weight of the bunch was 69.2g (Table 6).

#### *Biometric values of paddy of untreated paddy:*

The fifth treatment of untreated plot gave the yield of 88.7 g of seeds for five bunches, the plantlet per bunch was 8(optimum), the average height of plants was 60cm, the average fresh weight of the bunch was 36.6g (Table 7).

By the end of our experiment, 15ml of wood vinegar per litre of water gives the good results to comparing other treatment. It gives good result in yield, weight of the seed, height of the plant, plantlets per bunch and Fresh weight of the plant.

Environment-friendly growth enhancers for rice are being promoted to reverse the negative impact of intensive chemical-based and conventional rice farming on yield sustainability and environmental problems. Several rhizosphere microorganisms and pyrroligneous acids (PA) had demonstrated beneficial influence on growth, yield

and grain quality of rice. Since most of the previous study had evaluated the effect of PGPR and PA on paddy rice singly, the effect of combined application of these on the growth and yield of paddy rice and on some soil chemical properties were determined. A four factorial pot experiment was conducted to evaluate the effect of PGPR, PA in combination with fertilizers and on different soil types. There were 54 treatment combinations including the control with three replications under complete randomized design. Plant growth parameters were evaluated using standard procedures during tillering and heading stages. Rice yield and some soil chemical properties were determined at harvest. Results showed that inoculation of *Bacillus licheniformis* and *Fusarium fujikuroi* enhanced plant growth by increasing the plant height which could be ascribe to its ability to promote IAA and GA production in plants. Inoculation of *Rhizobium phaseoli* enhanced chlorophyll content indicative to its ability to improve the N nutrition. However, these plant growth benefits during the vegetative stage were override by the fertilizer application effect especially during the maturity stage and grain yield. High fertilization rates on coarse textured soil without nutrient loss resulted to high available nutrients and consequently high yield. Wood vinegar application however improved nutrient availability in soil which could be beneficial for improving soil quality. Further evaluation is necessary to fully assess the potential benefits that could be derived from inoculation of these organisms and wood vinegar application in different soil environment especially under different field conditions (Kang Wook Jeong *et al*, October 2015).

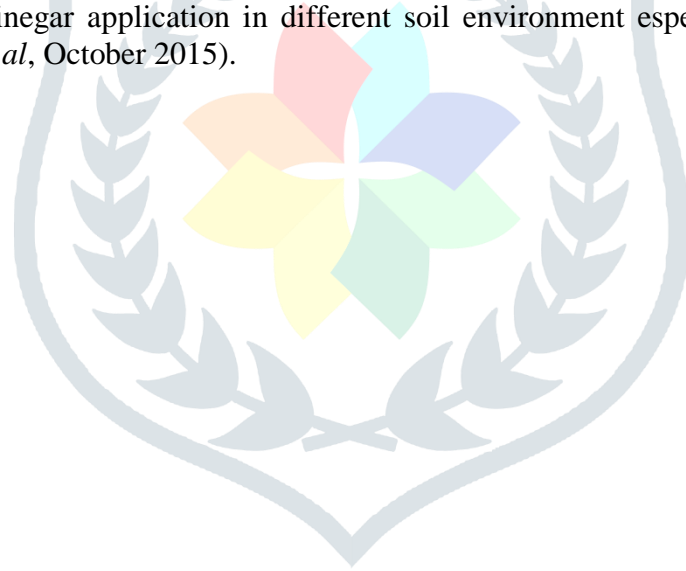


Table 1: pH Value of Various Concentration of Wood Vinegar:

Various Concentrations of Wood Vinegar	pH Value
Wood Vinegar as such	3.69
0.5 ml / 100 ml of water	6.27
1.0 ml / 100 ml of water	5.10
1.5 ml / 100 ml of water	4.85
2.0 ml / 100 ml of water	4.66

Table 2: pH Value of Soil After Spraying of Wood Vinegar:

Plots	pH Value
Plot A (Treatment 1)	7.62
Plot B (Treatment 2)	7.42
Plot C (Treatment 3)	7.75
Plot D (Treatment 4)	7.93
Plot E (Controlled)	7.34

Parameters	Plantlet - 1	Plantlet - 2	Plantlet - 3	Plantlet - 4	Plantlet - 5	Mean of five replicates
Plantlet per bunch	7	9	8	9	7	
Height of the plant	68 cm	65 cm	67.5 cm	58 cm	71 cm	5.9 cm
No of leaves		4	5	4	5	.6
Length of leaf	62 cm	55.5 cm	60.3 cm	52.5 cm	54.9 cm	7.04 cm
Width of leaf	1.1 cm	1.5 cm	1.3 cm	1.5 cm	1.4 cm	.36 cm
Fresh weight	44.7 g	62.7 g	50.0 g	67.7 g	47.7 g	4.54 g

Table 3: Effect of wood vinegar at 5ml / litre on biometric values of paddy:

Dry weight	26.4 g	43.8 g	27.8 g	42.4 g	22.8 g	2.64 g
Weight of seeds (100)	2.950 g	2.660 g	2.830 g	3.020 g	3.180 g	.928 g
Weight of Total seeds	105.4 g					

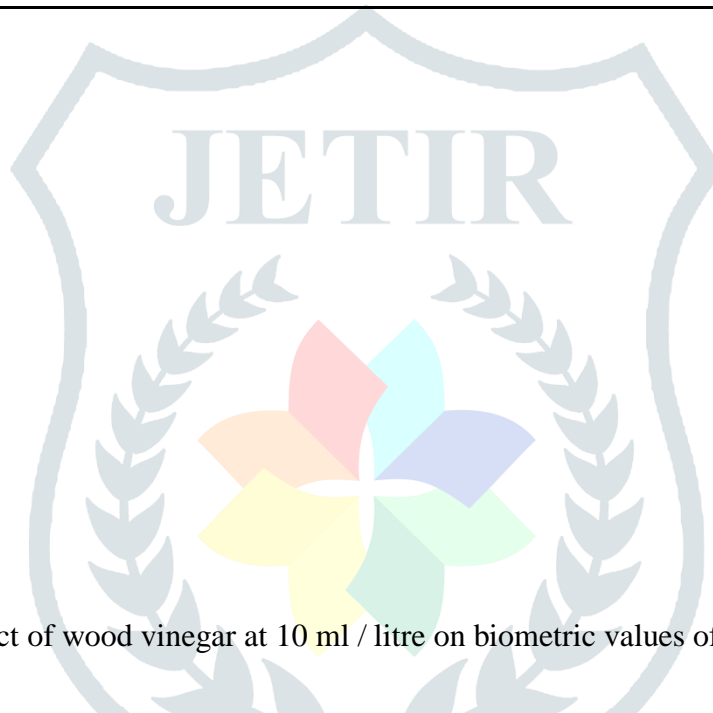


Table 4: Effect of wood vinegar at 10 ml / litre on biometric values of paddy

Parameters	Plantlet - 1	Plantlet - 2	Plantlet - 3	Plantlet - 4	Plantlet - 5	Mean of five replicates
Plantlet per bunch	6	9	11	8	9	8.6
Height of the plant	74 cm	68 cm	78 cm	76 cm	75 cm	74.2 cm
No of leaves	4	4	4	4	4	4
Length of leaf	62 cm	58.8cm	60 cm	53.5 cm	55.5 cm	57.96 cm
Width of leaf	1.6 cm	1.5 cm	1.4 cm	1.2 cm	1.5 cm	1.4 cm
Fresh weight	38.9 g	49.5 g	64.2 g	49.4 g	54.5 g	50.1 g
Dry weight	16.3 g	23.6 g	30.4 g	23.8 g	24.5 g	23.7 g
Weight of seeds (100)	2.720 g	2.930 g	2.760 g	2.767 g	2.620 g	2.759 g
Weight of Total seeds	118.5 g					

Table 5: Effect of wood vinegar at 15 ml / litre on biometric values of paddy:

Table 6: Effect of wood vinegar at 20 ml / litre on biometric values of paddy:

Parameters	Plantlet - 1	Plantlet - 2	Plantlet - 3	Plantlet - 4	Plantlet - 5	Average
Plantlet per bunch	6	7	11	6	8	7.6
Height of the plant	68 cm	78 cm	75 cm	74 cm	74 cm	73.8 cm
No of leaves	4	4	3	4	4	3.8
Length of leaf	65 cm	73 cm	62 cm	77 cm	64 cm	68.2 cm
Width of leaf	1.2 cm	1.2 cm	1.5 cm	1.4 cm	1.2 cm	1.3 cm
Fresh weight	36.2 g	42.2 g	69.2 g	52.2 g	48.3 g	49.63 g
Dry weight	15.5 g	23.7 g	54.5 g	25.6 g	23.5 g	28.56 g
Weight of seeds (100)	2.740 g	2.790 g	2.840 g	2.770 g	2.802 g	2.788 g
Weight of Total seeds	192.1 g					

Parameters	Plantlet - 1	Plantlet - 2	Plantlet - 3	Plantlet - 4	Plantlet - 5	Average
Plantlet per bunch	7	8	7	7	8	7.4
Height of the plant	60 cm	57 cm	56 cm	57 cm	60 cm	58 cm
NO of leaves	3	4	3	4	3	3.4
Length of leaf	57.7 cm	54.2 cm	57 cm	58 cm	51 cm	55.6 cm
Width of leaf	0.7 cm	0.8 cm	1 cm	0.8 cm	1.2 cm	0.9 cm
Fresh weight	34.5 g	36.6 g	27.6 g	27.4 g	32.6 g	31.7 g
Dry weight	16.8 g	16.4 g	14.5 g	13.4 g	12.4 g	14.7 g
Weight of seeds (100)	2.470 g	2.740 g	2.630 g	2.760 g	2.720 g	2.664 g
Weight of Total seeds	88.7 g					



Figure 1: Impact of Wood vinegar on improving the plant height of Paddy

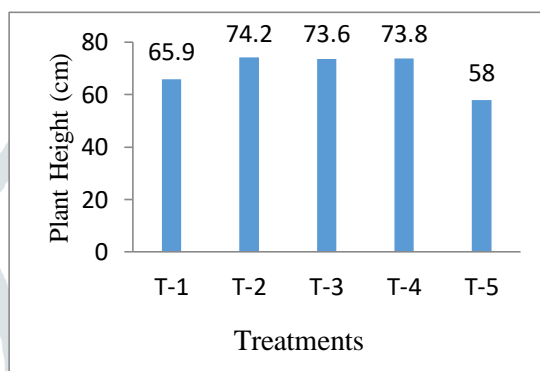


Table 7: Biometric values of paddy of untreated paddy:

Figure 2: Effect of wood vinegar on fresh and dry weight of paddy

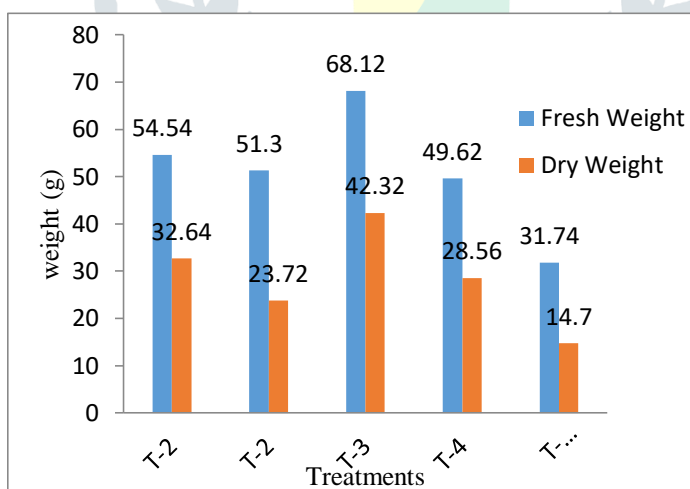
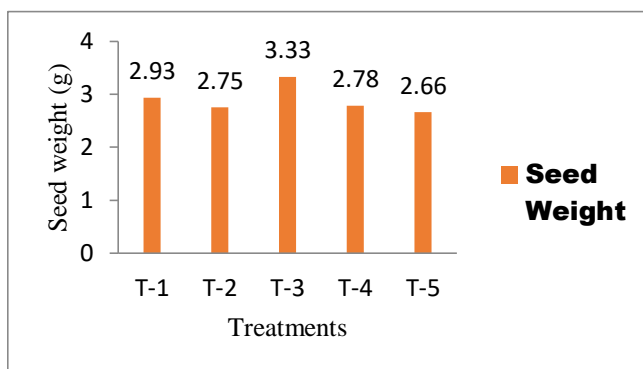


Figure 3: Influence of wood vinegar on paddy yield (Seed weight in gram)



## CONCLUSION

Finally, the paddy crop showed better response by receiving the wood vinegar at various doses. Based on our data observation wood vinegar sprayed plots recorded higher yield the biometric data proves the optimum dose of wood vinegar is 15 ml / 1 litre treated plots having comparatively higher biomass weight.

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