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Exploring the management strategies for wilt of lentil under natural farming system

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ABSTRACT: Natural farming employs natural resources to grow crops and manage disease and pests for high-quality harvests. This study evaluates the efficacy of natural products viz., *Panchgavya*, butter milk, cow dung, cow urine, ghee, mushroom extracts, spent mushroom substrate (SMS) and oils *in vitro* and *in vivo* against lentil wilt caused by *Fusarium oxysporum* f.sp. *lentis* by recording the percentage mycelium inhibition, impact on disease incidence and crop yield. The most effective products were further studied for elicitation of systemic acquired resistance in subjected plants. The poisoned food technique revealed highest mycelium inhibition of the pathogen i.e., 90 percent with *Badri* cow urine and *Panchgavya* at the 20 percent concentration. Both products also performed with similar efficacy over lentil wilt disease under field conditions. The seed treatment with *Panchgavya* reduced disease incidence to 1.82 percent in field, followed by *Badri* cow urine (2.44%). Moreover, the treatments with *Panchgavya* and *Badri* cow urine exhibited highest yield of 16.22 q/ha and 13.79 q/ha, respectively, demonstrating positive impact on plant growth factors. Furthermore, defense related enzymes viz., PAL, TP and Catalase were also found to be enhanced 48 hours post challenge inoculation in *Badri* cow urine and *Panchgavya* treated plants. Overall, the study presents promising sustainable options for lentil wilt management under natural farming systems, where no chemical options are available.

Key words: Animal products, lentil, natural farming, natural products, SAR, wilt

Natural farming places an emphasis on sustainability and ecological balance, in contrast to traditional farming methods that mostly rely on artificial inputs. By combining crops, trees and cattle, this method creates a diversified ecosystem that improves soil health and encourages biodiversity. Utilizing natural products and on-farm resources is essential to natural farming since it improves the nutritional value of the food produced while lowering reliance on outside inputs. Natural farming can produce nutrient-dense crops while preserving soil fertility and ecological integrity like the quality production of lentils, a staple legume prized for its high protein content (Anonymous, 2024).

Diseases like wilt, which can destroy lentil crops, are common and pose a serious threat to agriculture. Lentil wilt, primarily caused by the soil-borne fungus *Fusarium oxysporum* f. sp. *lentis*, poses a significant threat to lentil cultivation, leading to substantial yield losses that can reach up to 50 percent in heavily infested fields (Khalequzzaman, 2016). This pathogen infects lentil plants at various

growth stages, resulting in symptoms such as stunting, wilting and eventual death of the plants, often appearing in patches across the field (Rathod *et al.*, 2021). The economic impact is profound, as infected crops suffer reduced marketability due to seed discoloration and diminished yields, placing financial strain on farmers. Effective management strategies, including the development of resistant lentil varieties and integrated pest management practices, are crucial for mitigating the effects of *Fusarium* wilt and enhancing overall crop resilience (Chandra *et al.*, 2020; Mohammadi *et al.*, 2012). By encouraging healthy soil microbiomes that increase plant resistance to such diseases, natural farming tackles this problem. Farmers promote healthy microorganisms that naturally fight diseases and pests by avoiding artificial pesticides and fertilizers. In this ecosystem, the use of animal products—especially those from native breeds like the Desi cow—is essential. Reliance on hazardous chemicals is decreased by using cow dung and urine to produce bio-inputs that improve soil quality and promote plant health (Anonymous, 2024). The essential oils

produced from a variety of plants, such as neem and garlic, have been shown to possess strong antifungal activities against a wide variety of pathogens. These pathogens include those that are responsible for wilt disease in crops such as lentils (Chandra *et al.*, 2020).

Adopting natural farming techniques improves farming communities' economic stability in addition to increasing yields. By reducing production costs by using locally sourced supplies and encouraging intercropping techniques, farmers can increase their net incomes and create jobs in their communities. Additionally, natural farming is a promising substitute that promises to satisfy customer demand for organically farmed food while maintaining environmental sustainability as it grows internationally (ATARI Kolkata, 2024). With its focus on ecological balance and biodiversity, Natural Farming offers a viable route to sustainable farming methods that are advantageous to both farmers and consumers. Including these natural products in disease control methods not only helps minimize dependency on chemical pesticides, but it also adds to the sustainability of agricultural practices by encouraging biodiversity and soil health. Keeping in view, the need of sustainability and ecological balance, this study was done to explore the integration of these natural products for disease management while mitigating the negative effects of chemical pesticides.

MATERIALS AND METHODS

The research conducted at the Govind Ballabh Pant University of Agriculture and Technology in Pantnagar, Udham Singh Nagar, Uttarakhand, spanning a two-year timeframe from 2017 to 2019. The research was carried out under both *in vitro* and *in vivo* conditions to evaluate impact on *Fusarium oxysporum* f.sp. *lentis* (Accession Number MK452341) by utilizing the natural products *viz.*, *Panchgavya* (prepared from the products obtained from *Badri* cow breed), butter milk prepared from *Badri* cow breed, fresh cow dung extract prepared from *Badri* breed, 20 days old cow urine obtained from *Badri* breed, Spent Mushroom Substrate of *Agaricus biosporus* and oils (Mustard oil, olive oil,

sesame oil and castor oil) and Desi ghee of *Badri* breed at 20 percent concentration, as well as, the mushrooms (*Agaricus bisporus* (Strain Dutum), *Pleurotus florida* (Strain Florida), *Lentinula edodes* (Strain LE-17-07) and *Ganoderma lucidum*) mycelium and their extract were used for evaluation under *in vitro* and *in vivo* conditions, respectively. All the processes were conducted with strict adherence to the pertinent standards and regulations, assuring compliance. An exhaustive study of the data was conducted using Duncan's multiple range test (DMRT).

Evaluation of natural products under in vitro condition

All the natural products *viz.*, *Panchgavya* (prepared from *Badri* breed products, Table 1), butter milk (*Badri* Breed), Desi cow dung extract (*Badri* breed), Desi cow urine (*Badri* breed), Desi Cow ghee (*Badri* breed), Spent Mushroom Substrate (*Agaricus biosporus*) and oils (Mustard oil, olive oil, sesame oil and castor oil) at 20 percent concentrations were tested against the pathogen by incorporating them in PDA medium at a concentration of 20 percent as per the procedure given by Basak *et al.* (2002). Mushroom *viz.*; *Agaricus bisporus* (Strain Dutum), *Pleurotus florida* (Strain Florida), *Lentinula edodes* (Strain LE-17-07) and *Ganoderma lucidum* were tested using "Dual Culture Method" as described by Morton and Stroube (1955) with some modification. The impact of the products on the inhibition of mycelium growth of the pathogen was recorded as percent mycelium inhibition (PMI) for the analysis.

Table 1: List of Ingredients required for the preparation of *Panchgavya*

S.No.	Ingredients	Quantity
1.	Fresh Cow dung	5kg
2.	Cow's Urine	3 litres
3.	Cow's Milk	2 liters
4.	Cow's Curd	2 liters
5.	Cow's Ghee	500g
6.	Coconut Water	3 litres
7.	Ripe Banana Fruits	12 nos.
8.	Jaggery	500g with 3liters water

Field experiment

The susceptible variety L-9-12 of lentil was planted

in a 4.8 square meter plot, at a depth of 4-5 cm, utilizing the Randomized Block Design (RBD) in a wilt sick plot (10^7 microconidia/g of soil). Each treatment, along with a control, was replicated three times to ensure the methodology. Each plot represented a harmonious combination of lentil rows, exemplifying the intricacies of natural design. The crop received a moderate application of irrigation during its growing season and weeding was conducted five weeks after germination. Seed treatment is an effective method utilized to enhance the quality and performance of seeds. This process involves applying various substances to seeds, providing protection against diseases, pests and environmental factors, while also promoting germination and initial growth stages. In contemporary agricultural practices, the treatment of seeds is of paramount importance, especially for lentil seeds, which were treated with a 20 percent concentration of each natural products prior to the sowing, the seeds underwent a thorough twelve-hour treatment, succeeded by a controlled overnight incubation period. A control plot was meticulously maintained ensuring that no seed treatment was administered. The data on disease incidence 45 days after sowing then continuously at 25 Days interval till harvest was recorded along with the yield attributes (shoot length and root length) and yield of the crop.

The glass house experiment

The L-9-12 lentil variety, obtained from the Department of Genetics and Plant Breeding at Govind Ballabh Pant University of Agriculture and Technology in Pantnagar, Udham Singh Nagar, was grown in a rigorously controlled glasshouse setting. The experiment included three replications (30 plants per pot for each replication), in addition to the control groups that were subjected to pathogen inoculation only, without any other treatment. Treatment like *Badri* breed cow urine and *Panchgavya* prepared from *Badri* breed cow were further subjected for SAR analysis as these were found most effective against the pathogen under field and laboratory conditions. Both the treatments were used for the seed treatment at different concentration i.e., 10, 15 and 20 percent, thereby the treated seed

were sown in the pot containing sterilized soil. Thereafter following the seed germination (15DAS), the pots were inoculated with the pathogen maize sand medium (up to 10^3 microconidia per gram of soil). Root samples were collected prior to pathogen inoculation from five plants and later on at 24-hour intervals (24, 36, 72 and 96 hours) post-inoculation to evaluate enzyme activity, including PAL, TP and catalase, utilizing the methods outlined below. Following collection, the plant samples were immediately packed in ice bags and preserved in a deep freezer at -80°C for future study. Statistical analysis was performed using R software to determine the significance of differences in effects between treatments and their controls.

Preparation of samples and extraction of enzymes

Root samples, subjected to treatment and pathogen inoculation, were collected individually and rapidly homogenized in a pestle and mortar with extraction buffers (sodium phosphate, potassium phosphate and methanol) at a brisk 4°C , specific to the enzyme to be measured. The material was subjected to a spin at 10, 000 rpm for a duration of 20 minutes. Subsequently, the liquid was moved to a new tube for the analysis of enzymes like PAL, Catalase and Total Phenol.

Phenylalanine Ammonia Lyase (PAL) Activity

The research by Whetten and Sederoff (1992) indicates that the enzyme extract was obtained by homogenizing 1g of root samples in 2ml of 0.1M Sodium Phosphate buffer (pH 7.0) at a temperature of 4°C . Thereafter, the extract was exposed to a brief centrifugation, rotating for 20 minutes at a speed of 10, 000 revolutions per minute. The assay solution was formulated with 500 ml of Tris HCl (pH 8.8) at a concentration of 50 mM, supplemented with 600 μl of L-phenylalanine, adjusted to a concentration of 1 mM. A specific volume of 100 μl of the isolated supernatant was employed as the enzyme extract. The combination was permitted to interact at a regulated temperature of 30°C for one hour. A volume of 0.5 ml of 2N HCl was added to terminate the reaction. The conversion rate of L-phenylalanine to trans cinnamic acid was assessed by measuring absorbance at 290 nm with a spectrophotometer. The

final value was articulated as O.D./min/g of fresh tissue with accuracy.

Catalase Activity

The catalase activity was assessed using a spectrophotometric technique, as described by Dhindsa *et al.* (1981). The root sample was homogenized in an extraction buffer and centrifuged at 10,000 rpm for 20 minutes, yielding a crude extract. To prepare the reaction mixture, combine 100 µl of enzyme extract with 50 mM phosphate buffer (pH 7.0) and 15 mM hydrogen peroxide, resulting in a total volume of 2 ml. The evaluation of catalase activity was monitoring the reduction in absorbance at 415 nm as hydrogen peroxide decomposed, measured as A415/min/g of fresh tissue.

Total Phenol (TP) activity

The total phenolic content was assessed by the addition of the Folin–Ciocalteu reagent and sodium carbonate to the supernatant. The absorbance of the reaction mixture was measured at 725 nm and the concentration was determined using a standard curve established using known amounts of gallic acid as the reference standard.

RESULTS AND DISCUSSION

Evaluation of Natural Products under in vitro conditions employing PDA amendment method

The data regarding percent mycelium inhibition (PMI), presented in Table 2 and figure 1, revealed the impact of the treatments against the lentil wilt pathogen *Fusarium oxysporum* f.sp. *lentis*, reflecting the efficacy of each treatment in suppressing the mycelial growth of fungal infections under *in vitro* conditions. Among the treatments, *Badri* cow breed urine and *Panchgavya* at 20 percent concentration proved to be the most efficacious, each showing a PMI of 90 percent, indicating their significant potential against fungal pathogen. Moreover, cow dung extract exhibited considerable efficacy with a PMI of 75 percent at 20 percent concentration also signifying its applicability in the management strategies.

Mustard Oil followed by Castor Oil, Linseed oil,

Ghee, Butter Milk, Linseed oil demonstrated PMIs in a range 38 to 45 percent. These products demonstrated potential as adjunctive strategy in integrated disease management systems. Conversely, treatments such as Sesame Oil and SMS extract demonstrated low PMIs (below 30%), signifying minimal efficacy in suppressing mycelial growth. The effective treatments, specifically *Badri* cow urine and *Panchgavya*, demonstrated potential for future use in agriculture and natural methods against fungal diseases.

The efficacy of a variety of natural products, such as *Panchgavya*, in the treatment of plant diseases has been extensively documented by several researchers. Kumar *et al.* (2010) established that *Maha Panchgavya* efficiently managed *Pythium aphanidermatum*, attaining total disease suppression in tomatoes when used in conjunction with neem extracts. Chadha *et al.* (2013) documented a notable 88.9 percent disease control of stalk rot in cauliflower with *Panchgavya* at full strength. Serfoji *et al.* (2015) discovered that a 5 percent foliar spray of *Panchgavya* markedly diminished the severity of brown leaf spot (*Alternaria solani*) in tomatoes. Research by Sathasivam *et al.* (2015) demonstrated that cow urine displayed considerable antifungal efficacy against pathogens like *Fusarium oxysporum*, *Rhizoctonia solani* and *Sclerotium rolfsii*, with inhibition rates of up to 78.57 percent at a 15 percent concentration. Das *et al.* (2018) observed that the integration of *Panchgavya* with other biopesticides improved disease management in soybean rust, demonstrating its promise as a sustainable alternative to chemical pesticides for diverse crops and pathogens. Similarly, the application of cow urine in integrated disease control has been thoroughly researched, proving its efficacy as a growth stimulant and antifungal agent. The study revealed that cow urine can successfully manage these fungal infections, endorsing its use in disease management measures. Kgasudi and Mantswe (2020) discovered that cow urine, utilized either independently or in conjunction with cow dung, markedly diminished the occurrence of blight disease induced by *Phyllosticta ophiopogonis* on ribwort plants, illustrating cow urine's potential to

improve plant health and alleviate disease effects. These data jointly highlight the efficacy of cow urine and *Panchgavya* as a sustainable substitute for synthetic chemicals in agriculture, promoting plant development and disease control.

Evaluation of mushroom under in vitro conditions employing dual culture method

The results presented in Table 2 and figure 2, regarding the percent mycelium inhibition of the pathogen employing dual culture method with mushrooms, *Ganoderma lucidum* (40.11%) was found most effective followed by *Pleurotus florida* (34.90%), *Lentinula edodes* (33.93) and *Agaricus bisporus* (22.82%). All the treatments had a significant impact on the reduction in mycelial growth of the pathogen. From the present study, it was observed that medicinal mushrooms also have the potential to inhibit the growth of the fungal pathogens. The results obtained are following the Sasaki *et al.* (2001) and Badalyan *et al.* (2002) who found *Ganoderma lucidum* superior over other xylophilic mushrooms for its efficient antagonistic properties against phytopathogens. Antagonistic properties of *Lentinula edodes* was studied by Sasaki *et al.* (2001) against *Helminthosporium* sp, *Fusarium solani* and *Phomopsis sojae* and reported the strain 46 and K2 effective against the fungus. Ganodermin an antifungal protein was found antifungal against the *F. oxysporum* (Wang and Ng, 2006).

Evaluation of the products under field conditions

The data (Table 2) highlighted the effectiveness of various treatments on plant growth, yield and disease incidence (DI). *Panchgavya* proved to be the most beneficial treatment, achieving significantly high yield of 16.22 q/ha, with a root length of 20.07 cm, a shoot length of 47.55 cm and a DI of 2.44 followed by BCU treatment, which yielded 13.79 q/ha, accompanied by a root length of 18.61 cm, a shoot length of 41.26 cm and a DI of 1.82. The Cow Dung treatment also performed well, yielding 7.49 q/ha with a DI of 3.02. In contrast, the control group showed the lowest performance, yielding only 4.65 q/ha, with a root length of 13.34 cm, a shoot length of 26.38 cm and a DI of 5.26. Other treatments such

as Ghee (6.33 q/ha, DI 4.30), Mustard Oil (7.89 q/ha, DI 3.04), and *Ganoderma lucidum* extract (7.77 q/ha, DI 2.92) showed moderate results. Overall, the data demonstrated that organic treatments significantly enhanced plant growth and yield while effectively managing disease incidence compared to traditional methods and controls. Research has shown that *Panchgavya* enhances soil health by increasing the availability of macronutrients and micronutrients, as well as fostering beneficial microorganisms in the soil (Beulah, 2021; Just Agriculture, 2021). These beneficial microbes not only improve nutrient uptake but also contribute to the overall resilience of plants against pathogens (TNAU Agritech Portal, 2021). The ability of *Panchgavya* to restore yield levels when transitioning from inorganic to organic farming within the first year has been well-documented (PMC, 2022). This aligns with findings by Degu *et al.* (2020), who noted that organic amendments like *Panchgavya* could significantly reduce disease incidence while enhancing crop productivity. Furthermore, the use of *Panchgavya* has been associated with improved water retention in soils and reduced irrigation needs due to its capacity to form a protective film on plant surfaces, which minimizes evaporation (Agrifarming, 2021). This characteristic is particularly beneficial in drought-prone areas, as it allows plants to withstand prolonged dry periods while maintaining health and productivity. Additionally, the nutrient-rich composition of *Panchgavya*—including essential vitamins and growth regulators like auxins and gibberellins—has been shown to stimulate plant growth and improve overall crop quality (Daily Dump, 2021). Hence, it can be concluded that, this study underscores the importance of *Panchgavya* as a sustainable agricultural practice that not only enhances crop yields but also promotes soil health and reduces dependency on chemical fertilizers. The integration of such organic treatments into farming systems can lead to more resilient agricultural practices that benefit both farmers and the environment.

Study on the Systemic Acquired Resistance

The data presented in Table 3 and figure 3 indicated

Table 2: Effect of different products on inhibition in the mycelial growth of the pathogen, *Fusarium oxysporum* f.sp. *lentis* on 9th day of incubation and on Av. disease incidence, Av. Root lt., Av. Shoot lt. and Av. yield of the lentil

S. No.	Treatment	(Av.) DI *	Root Lt.(cm)	Shoot Lt.(cm)	Yield (q/ha)	PMI*
1.	Butter Milk	4.67ab	14.32fg	31.27h	5.03fg	35.84fg
2.	Ghee	4.30abc	16.04def	32.73h	6.33efg	35.99fg
3.	Cow Dung extract	3.02 ^{abc}	16.69 ^{cde}	40.45 ^{cde}	7.49def	75.00b
4.	<i>Badri</i> cow urine	1.82e	18.61abc	41.26 ^{cde}	13.79b	90.00a
5.	<i>Panchgavya</i>	2.44de	20.07a	47.55a	16.22a	90.00a
6.	Mustard oil	3.04 ^{cde}	16.67 ^{cde}	41.99b ^{cde}	7.89de	45.40d
7.	Sesame oil	3.91 ^{abcd}	17.17bcd	43.03bc	7.40def	15.85i
8.	Castor oil	3.51bcd	16.71 ^{cde}	37.79efg	6.82efg	41.40e
9.	Linseed oil	3.46bcd	15.96def	34.61fgh	7.25def	38.37ef
10.	<i>Ganoderma lucidum</i>	2.92 ^{cde}	18.37abc	44.48abc	7.77de	40.11e
11.	<i>Pleurotus sp.</i>	3.48bcd	19.04ab	43.11bc	6.27efg	34.90fg
12.	<i>Lentinula edodes</i>	4.04abc	18.33abc	42.32bcd	6.90defg	33.93g
13.	<i>Agaricus biosporus</i>	4.75ab	16.71 ^{cde}	38.62def	5.53efg	22.82h
14.	Spent Mushroom Substrate	3.83 ^{abcd}	18.70abc	46.20ab	10.98c	21.00h
15.	Control	5.26 a	13.34g	26.38i	4.65g	0.00k
	(P< 0.05)	0.0009	1.19E-06	2.51E-11	1.01E-10	<2e-16

*Values followed by different letters are significantly (p < 0.05) different from each; Values written for DI are transformed value of the percent values

Table 3: Enzymatic activity enhanced by the *Badri* cow urine and *Panchgavya* at different concentration in glass house conditions

Treatment/ Hour's interval	Catalase (Δa_{415} /min/g of fresh tissue)				PAL (Δ O.D. /min/g of fresh tissue)				TPC (mg GAE/g dry extract wt)			
	24	48	72	96	24	48	72	96	24	48	72	96
PG 10	1.18b	0.88c	0.54def	0.48 ^{defgh}	0.65c	0.56cd	0.39 ^{defg}	0.22 ^{efgh}	2.62b	1.55f	0.99 ^{hijk}	0.84 ^{kl}
PG15	1.40a	0.91c	0.57de	0.49 ^{defgh}	1.1b	0.57cd	0.43 ^{cdef}	0.25 ^{fghi}	2.9a	1.86e	1.04 ^{hij}	0.88 ^{ijkl}
PG20	1.553a	0.98c	0.62d	0.52 ^{defg}	1.68a	0.58cd	0.44 ^{cdef}	0.32 ^{efgh}	3.03a	1.89e	1.08 ^{ghi}	0.96 ^{hijkl}
BCU10	0.22jk	0.36 ^{efefgh}	0.32 ^{efgh}	0.28 ^{hij}	0.46 ^{cdef}	0.51 ^{cde}	0.2 ^{efgh}	0.1ij	0.85 ^{ijkl}	1.89e	1.13gh	0.82 ^{ijkl}
BCU15	0.26ij	0.37 ^{efefgh}	0.33 ^{efgh}	0.28 ^{hij}	0.49 ^{cde}	0.52 ^{cde}	0.21 ^{efgh}	0.15 ^{hij}	0.89 ^{ijkl}	2.09d	1.26g	0.87 ^{ijkl}
BCU20	0.27ij	0.51 ^{defg}	0.34 ^{efgh}	0.3 ^{efgh}	0.5 ^{cde}	0.53 ^{cde}	0.28 ^{fghi}	0.18 ^{hij}	0.97 ^{hijkl}	2.28c	1.49f	0.95 ^{hijkl}
CONTROL	0.03 ^k	0.04 ^k	0.3 ^k	0.3 ^k	0.04 ^{ij}	0.05 ^j	0.03 ^j	0.02 ^k	0.25m	0.78 ^{kl}	0.76l	0.24 ^m
SEM	A: 0.033	B: 0.025	AB: 0.067		A: 0.033	B: 0.047	AB: 0.067		A: 0.033	B: 0.025	AB: 0.067	
(P< 0.05)	< 2.2e-16	6.13E-15	6.13E-15		< 2.2e-16	1.53E-07	< 2.2e-16		< 2.2e-16	< 2.2e-17	< 2.2e-18	

*Values followed by different letters are significantly (p < 0.05) different from each other

significant variations in catalase, phenylalanine ammonia lyase (PAL) and total phenolic content (TP) across different treatments and time intervals. Based on the data, a comparative analysis between *Badri* Cow Urine (BCU) and *Panchgavya* (PG) revealed significant differences in their effects on catalase activity, phenylalanine ammonia lyase (PAL) activity and total phenolic content (TPC). Notably, the PG20 treatment exhibited the highest catalase activity (1.553 Δa_{415} /min/g of fresh tissue) and PAL activity (1.68 Δ O.D./min/g of fresh tissue) at 24 hours, suggesting that this treatment significantly enhanced the production of these enzymes. In contrast, the maximum catalase activity for BCU was only 0.36 Δa_{415} /min/g at 48 hours for BCU15,

indicated that cow urine did not enhance catalase production as effectively as *Panchgavya*. Similarly, PAL activity was significantly greater in PG treatments; for instance, PG20 had a PAL activity of 1.68 Δ O.D./min/g at 24 hours, while BCU treatments peaked at just 0.51 Δ O.D./min/g for CU10 at 48 hours. Total phenolic content followed a similar trend, with PG20 achieving the highest TPC of 3.03 mg GAE/g dry extract weight at 24 hours compared to CU's maximum of 1.89 mg GAE/g for CU10 at 48 hours. In contrast, the control group demonstrated minimal enzyme activity, with catalase peaking at only 0.30 Δa_{415} /min/g and PAL at 0.05 Δ O.D./min/g. Furthermore, TPC was significantly higher in the PG20 treatment (3.03 mg GAE/g dry extract weight), reinforcing the notion that specific

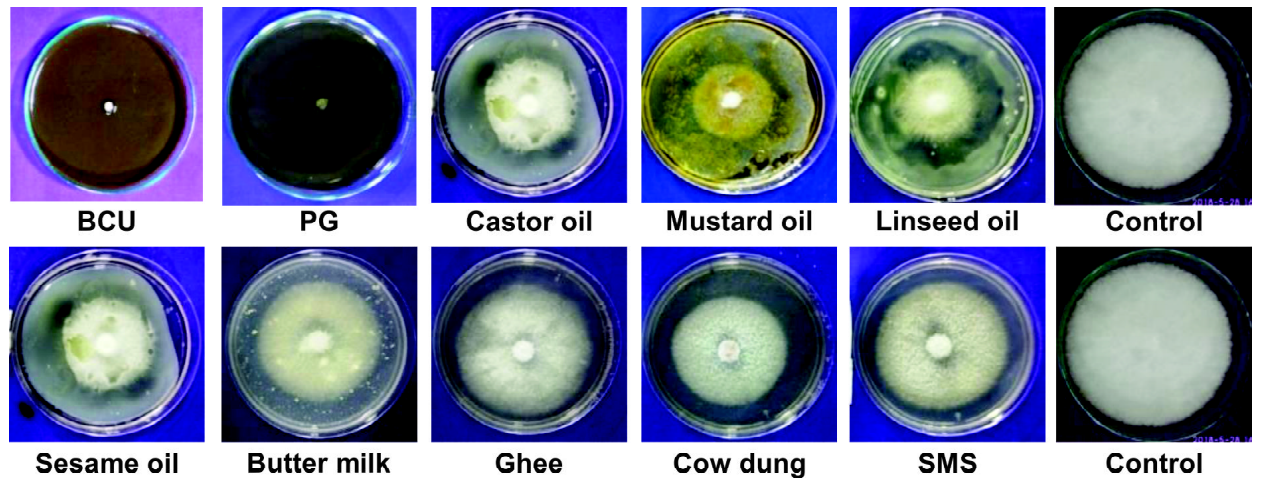


Fig. 1: Inhibition in the mycelial growth of the pathogen, *Fusarium oxysporum* f.sp. *lentis* 9th day of incubation using 20 percent concentrations of natural products in PDA medium



Fig. 2: Inhibition in the mycelial growth of the pathogen, *Fusarium oxysporum* f.sp. *lentis* on 9th day of incubation using dual culture method with mushrooms

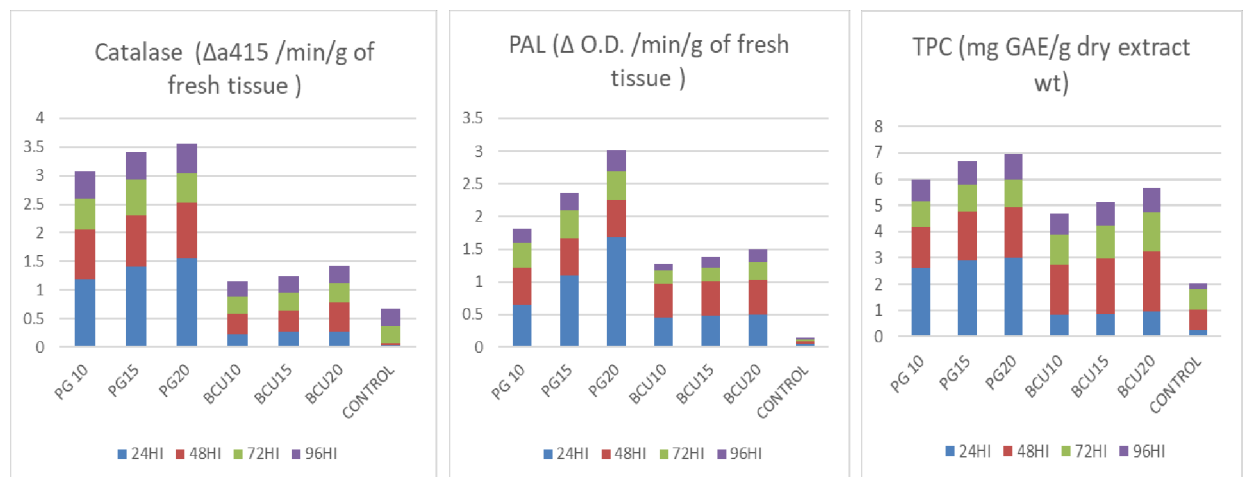


Fig. 3: Enzymatic activity induced by *Panchgavya* (PG) and *Badri* Cow urine (BCU) at different doses 10, 15 and 20 percent under glass house condition

treatments could substantially boost both enzymatic activities and phenolic compounds. These findings suggested that *Panchgavya*, with its combination of cow-derived products, provides a synergistic effect

that significantly enhances enzymatic activities and phenolic compounds compared to cow urine alone, making it a more effective option for improving plant health and resilience.

Cow urine (CU) and *Panchgavya* (PG) are both traditional products derived from cows, widely used in Ayurveda and organic farming. Its application in agriculture includes being used as a natural pesticide and fertilizer due to its antifungal and antibacterial properties. *Panchgavya* is a more complex formulation that consists of five products derived from cows: cow dung, cow urine, milk, curd and ghee. This mixture is believed to enhance soil fertility, improve crop health and provide numerous health benefits when consumed or applied externally. *Panchgavya* acts as a holistic remedy that supports plant growth and boosts immunity in animals and humans due to its rich microbial content (Kumar *et al.*, 2022). While cow urine can be used independently for specific health issues, *Panchgavya* offers a broader spectrum of benefits by combining multiple cow-derived products. It is particularly effective in organic farming practices as it promotes sustainable agriculture without the use of harmful synthetic fertilizers or pesticides (TNAU Agritech Portal, 2021).

CONCLUSION

The study on management strategies for wilt in lentil under a natural farming system revealed promising approach that enhanced plant health and yield besides non- reliance on chemical inputs. A variety of soil-borne and seed-borne fungal plant diseases can be inhibited by *Panchagavya*. Recent research on the usage of *Panchgavya* as a soil fertility agent, insect repellent, disease management and plant growth promoter is revealed from the earlier studies. Because of these unique qualities, *Panchgavya* can be the most appropriate for integrated nutrient, disease and pest management programs under natural farming system.

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