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Evaluating the Efficacy of Chemical, Botanical, and Cow Urine-Based Interventions for Sustainable Management of Major Lentil Diseases

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ABSTRACT

Lentil is one of Bangladesh's most significant pulse crops, but fungal diseases, especially Stemphylium blight caused by Stemphylium botryosum, severely limit its productivity. The current study was conducted at the Regional Agricultural Research Station (RARS), Jashore, to assess the efficacy of selected fungicides, botanical extracts, and cow urine in managing major lentil diseases and improving yield performance. The experiment used BARI Masur-6 in a Randomized Complete Block Design with three replications during three consecutive rabi seasons (2013–14, 2014–15, and 2015–16). Treatments included cow urine (5%); garlic, datura, mahogany leaf and seed, neem, and fern leaf extracts (5% solutions); fungicides such as Dithane M-45, Bavistin, Cupravit, Ridomil Gold, and Rovral; and an untreated control. Yield and yield-contributing characters were recorded, and disease severity was measured using the Percent Disease Index (PDI). The findings showed that seedling mortality was mainly linked to soil-borne infections and declined with increasing plant age. Higher temperatures and humidity promoted disease development, as indicated by positive linear associations between PDI and maximum and minimum temperatures, as well as relative humidity. Across years, Rovral 50WP consistently outperformed all treatments in reducing disease severity and improving yield quality. Rovral-treated plots produced the highest stover production and grain yield (2.79, 2.07, and 2.13 t ha^{-1} in the corresponding years), followed by Ridomil Gold, Dithane M-45, fern leaf extract, and cow urine. Compared with fungicides, botanical extracts and cow urine showed moderate efficacy but performed better than the untreated control, which consistently yielded the lowest. The results indicate that Rovral 50WP is highly effective against Stemphylium blight and improves lentil yield, while cow urine and some botanical extracts have potential as environmentally acceptable alternatives for integrated disease management.

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Introduction

The lentil (Lens culinaris Medik.) has been cultivated for almost 8000 years, making it one of the oldest and most widely used pulse crops worldwide. It is prized for both its high protein content and its special capacity to improve soil fertility by fixing atmospheric nitrogen. Pulses are a significant source of plant protein for human nutrition in Bangladesh and are an essential component of daily diets (Sattar et al., 1996). Lentils are grown all throughout the nation, but especially in the midwestern areas, including the districts of Jessore, Jhenidah, Magura, Faridpur, Rajbari, Kushtia, Chuadanga, Meherpur, and Pabna (Afzal et al., 1999). Despite its significance, Bangladesh's lentil yield remains very low compared to major lentil-producing nations such as Ethiopia, Syria, Turkey, Canada, and the United States. Lentils were grown on roughly 2,49,000 hectares during the 2016–2017 cropping season, yielding about 2,69,000 metric tons (Azad et al., 2017). Bangladesh's low lentil output is caused by a number of causes. Among these, using subpar seeds is a significant barrier. During storage, pulse seeds are extremely vulnerable to deterioration caused by high temperatures and high relative humidity, which significantly affects crop establishment and germination. According to reports, the country's overall pulse production has significantly decreased due to this degradation (The Business Standard, 2026).

In addition, the low yield potential of the existing cultivars leads to a reduction in production, while farmers' delayed sowing, lack of seed availability, and the problems posed by disease pressure and reduced cultivation area are other factors contributing to the decrease in lentil production (Ahmed et al., 2026; Feleke et al., 2021). One of the most important limitations on lentil output is disease susceptibility. Approximately 15 pathogens that cause 17 lentil illnesses have been identified in Bangladesh thus far (Ahmed, 1985). The three main illnesses are foot rot (Sclerotium rolfsii), rust (Uromyces fabae), and Stemphylium blight (Stemphylium botryosum). Stemphylium blight is a severely damaging defoliating disease that was originally documented in Bangladesh by Bakr and Zahid (1986). Under field conditions, this disease has been shown to cause yield losses of up to 62% (Bakr and Ahmed, 1992). According to recent research, Stemphylium blight is one of the most damaging lentil diseases in South Asia, resulting in significant production losses when favorable environmental factors such high humidity and moderate temperatures are present (Kumar et al., 2020). In Bangladesh as well as nearby nations like India and Nepal, where epidemic outbreaks can cause significant crop failure, the disease has become a significant barrier to sustainable lentil production. Lentil cultivation has been further threatened by the recent spread of the disease to southern Bangladesh, particularly in the districts of Barisal and Bhola. Plant infections can develop and spread quickly in Bangladesh due to its climate, which highlights the need for efficient disease management techniques. To avoid environmental risks and reduce excessive reliance on synthetic pesticides, integrated disease management systems that combine chemical fungicides with environmentally friendly alternatives are becoming increasingly important (Sarker et al., 2021). The use of disease-resistant cultivars is considered the most cost-effective and efficient management method. Chemical treatment is still a quick and effective way to manage plant diseases in the field, though. Due to their antifungal properties and efficacy against a variety of plant diseases in both laboratory and field settings, plant-derived extracts, including neem, garlic, and datura, have attracted attention in recent years (Rahman et al., 2022). Similarly, cow urine, a traditional source of organic inputs, is also being explored as a plant disease management tool, with claims that it contains antibacterial properties (Patel et al., 2023; Akter et al., 2026). By reducing the negative environmental impacts of conventional fungicides, these substitutes offer a hopeful future for sustainable agriculture. To identify effective and sustainable disease management options for increasing lentil productivity, the current study assessed the efficacy of specific chemical fungicides, botanical extracts, and cow urine in controlling Stemphylium botryosum under field conditions. This was done in light of the significance of lentils and the growing threat of Stemphylium blight.

Materials and Methods

Experimental Site

The experiment was conducted at the field laboratory of the Regional Agricultural Research Station (RARS), Jashore, Bangladesh, located at approximately 23.18° N latitude and 89.19° E longitude in the southwestern region of the country.

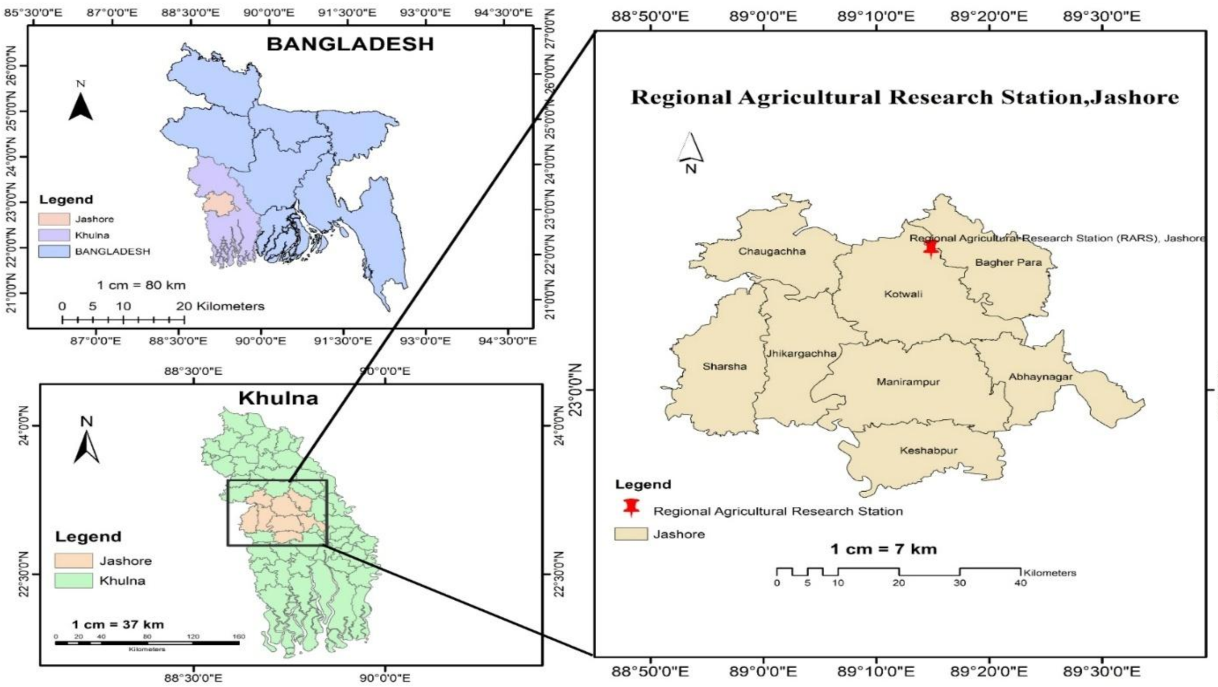

Figure 1: Study location- Regional Agricultural Research Station (RARS), Jashore, Bangladesh.

Planting Material

The lentil variety BARI Masur-6 was used as the experimental crop. Seeds obtained from the Bangladesh Agriculture Research Institute (BARI), Gazipur.

Experimental Treatments Details

Various chemicals and botanicals were sprayed on the standing crop. Those were Garlic clove extract (5% w/v aquas solution) (Tohami *et al.* 2002), Datura leaf extract (5% w/v aquas solution) (Tohami *et al.* 2002), Mehogoni leaf extract (5% w/v aquas solution) (Tohami *et al.* 2002), Mehogoni seed extract (5% w/v aquas solution) (Tohami *et al.* 2002), Neem leaf extract (5% w/v water solution) (Tohami *et al.* 2002), Fern leaf extract (5% w/v aquas solution) (Tohami *et al.* 2002), Cow urine (5% v/v water solution) (Meena, 2012), Dithane M-45 (Mancozeb 80% + manganese ethylene) @ 0.2%, Bavistin 50WP (50% methyl 2 benzimidazole) @ 0.15%, Cupravit (Copper oxycloride with 50% metallic copper) @ 0.3%, Ridomil gold (Metalaxyl 80 g a.i./kg + Mancozeb 640 g/kg) @ 0.2%, Rovral 50WP (Ipridion 0.2%) and Control (No treatment).

Fertilizer application

Fertilizers were applied according to the recommendation of FRG 2012 (Fertilizer Recommendation Guide, BARC). Urea, TSP and MOP were applied at the rate of 45 kg, 85 kg and 35 kg per hectare. All the fertilizer was applied at the time of last tillage operation.

Date of sowing

Seeds were sown during the 1st year on 15 November 2013, the 2nd year on 25 November 2014 (In this year, rainfall occurred in the first week of November, so sowing of lentil was delayed 10 days), and the 3rd year on 15 November 2015, respectively.

Experimental Design

A Randomized Complete Block Design (RCBD) with three replications was used to set up the experiment. To reduce experimental error, the experimental field was split into three blocks, each serving as a replication. All treatment combinations were randomly assigned within each block. Each plot was 4 m × 3 m (12 m^2). Replications were spaced 1.5 m apart, while adjacent plots were spaced 1.0 m apart. To promote healthy plant growth and ease intercultural operations, row-to-row spacing was kept at 30 cm. A seed rate of 35 kg ha^{-1} was used to sow the crop.

Plant disease index (PDI)

Stemphylium blight was rated on a 0-5 scoring scale (Bakr et al. 2010). The rating scale was explained as:

0 = no infection (HR)
1 = few scattered leaves infected but no twig blighted (R)
2 = 5-10 % leaflet infected and / or few scattered twigs blighted (MR)
3 = 11 – 20 % leaflet infected and / or 1 – 5 % twigs blighted (MS)
4 = 21 – 50 % leaflet infected and / or 6 – 10 % twigs blighted (S) and
5 = above 51 % leaflet infected and / or more than 10 % twigs blighted (HS)

Preparation of extract

Leaf (10 g) was taken and blended with a blender in 1 liter of distilled water to make 1% solution of the extract. Garlic clove extract (1%) solution was made in the same way. In case cow urine 10 ml fresh cow urine was mixed with 1 litre water.

Method of spraying

All the plant extracts and fungicides were mixed with water and taken to the research plot in separate conical flasks and sprayed to the plots by spraying gun (Figure 1 and 2). First, second and third spraying were done at 30, 45 and 60 days after sowing (DAS).

Data recorded

Data were collected on key growth, disease, and yield parameters, including germination percentage, plant population per square meter (m^{-2}), number of pods per plant, number of seeds per pod, Percent Disease Index (PDI), thousand-grain weight (g), seed yield (kg ha^{-1}), and stover yield (t ha^{-1}).

Harvesting

Harvesting was done at 110 DAS in 1st, 2^{nd} and 3^{rd} year experiment.

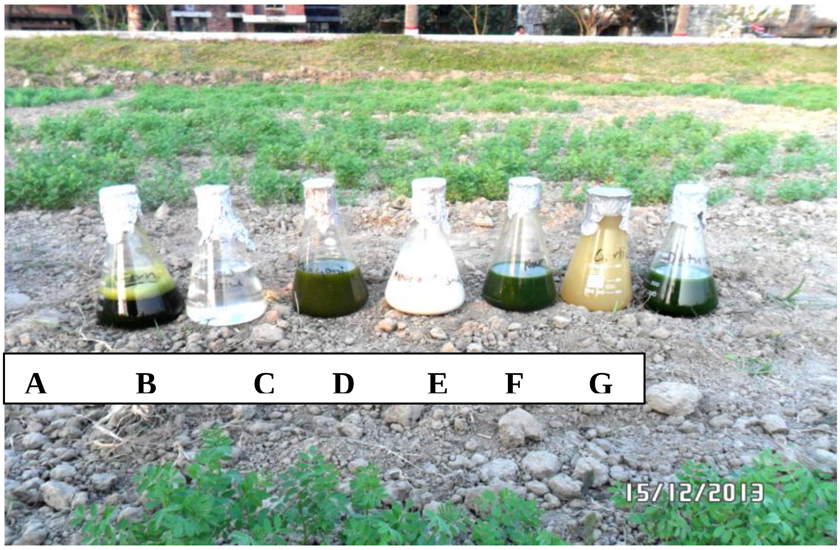

Figure 2. A. Fern leaf extract, B. Cow urine C. Mehogani leaf extract, D. Mehogani seed extract, E. Datura leaf extract, F. Garlic extract and G. Neem leaf extract in experiment field

Figure 3. Different botanical extracts, cow urine and fungicides sprayed in the experiment field

Statistical Analysis

Data were subjected to analysis of variance (ANOVA) using MSTAT-C software. Treatment means were compared using Duncan's Multiple Range Test (DMRT) at $P \leq 0.05$. Linear regression analyses were performed to determine relationships between seed grade proportions and germination, seedling mortality and age, and PDI with weather variables (maximum temperature, minimum temperature, and relative humidity).

Results and Discussions

Seedling mortality in field condition

A significant positive linear relationship was established between the proportion of apparently healthy seed (Grade-1) and germination percentage, both across varieties ($y = 42.12 + 0.537x$; $R^2 = 0.657$) and across locations ($y = 47.58 + 0.478x$; $R^2 = 0.704$), indicating that germination percentage increases predictably and proportionally as the proportion of Grade-1 seed increases (Figure 3). The positive linear associations ($R^2 = 0.657$ for varieties; $R^2 = 0.704$ for locations) confirm that the physical appearance of lentil seeds is a reliable proxy for their germinability and overall physiological quality. The marginally stronger association at the location level ($R^2 = 0.704$) suggests that environmental and post-harvest management factors influencing seed health at the field level also have a consistent, uniform effect on germination capacity. From an agronomic standpoint, this relationship provides a strong quantitative justification for recommending pre-sowing visual seed grading as a no-cost practice that simultaneously improves germination rates and reduces the carry-over of seed-borne inoculum. Similar positive relationships between seed vigour and germination have been documented in chickpea (Mortuza et al., 2002) and mung bean (Hasan et al., 2010).

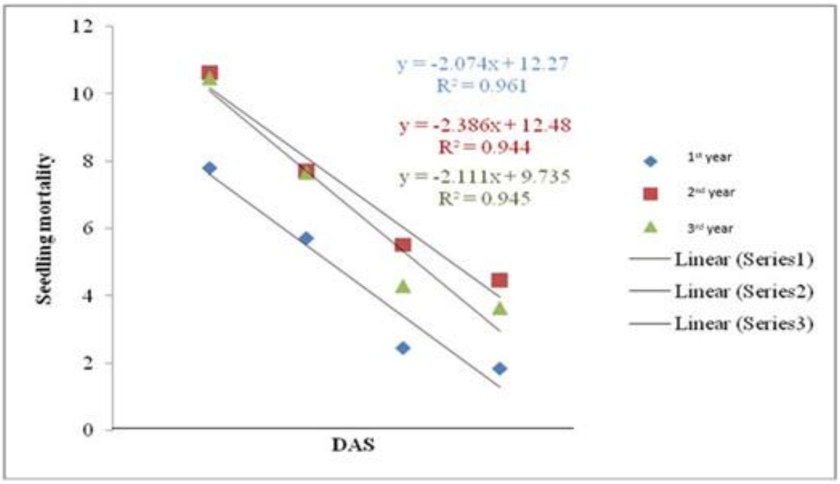

Figure 4. Relation between seedling mortality and seedling age

Plant population meter^{-2}

Plant population per square meter ranged from 328 to 357 in three years of observation, and the results did not show a significant difference among the treatments. Because data were recorded after germination in field at that time no treatment was applied. In the first year, the highest plant population was recorded in the Cupravit-treated plot (357), followed by the garlic clove extract (356), the fern leaf extract (355), and the control (355). The lowest plant population was recorded in Dithane M-45 (337) followed by mahogany leaf extract (340) and Ridomil gold (342). In second year, the highest plant population was recorded in the plot treated by mahogany leaf extract (355) followed by Cupravit (353) and fern leaf extract (351). The lowest plat population was found in Dithane M-45 (330) followed by neem leaf extract (334) and datura leaf extract (340). In third year, field trial the highest plant population was observed in garlic clove extract (343) followed by cow urine (342), neem leaf extract (341), fern leaf extract (341) and Ridomil gold (341). The lowest plant population was observed in Rovral (328), control (331) and mahogany leaf extract (333).

Plant height

Lentil plants varied in height from 43 to 50 cm. There were no notable variations in the data collected across three seasons. The plot treated with Cupravit had the maximum plant height in the first year of the field trial (50.30 cm), followed by fern leaf extract (50.00 cm) and cow urine (49.70 cm). Neem leaf extract had the lowest plant height (45.33 cm), followed by mahogany leaf extract (46.67 cm) and mahogany seed extract (45.67 cm). The treatment fern leaf extract had the maximum plant height during the second-year field trial (49.00 cm), followed by Cupravit (48.30 cm) and mahogany leaf extract (48.00 cm).

Dithane M-45 had the lowest plant height (46.70 cm), followed by Datura leaf extract (47.00 cm). In the third year of field testing, the datura leaf extract treatment produced the tallest plant (47.00 cm), followed by the garlic clove extract (45.76 cm) and the mahogany leaf extract (48.00 cm). Fern leaf extract had the lowest plant height (43.00 cm), followed by cow urine, Rovral (43.67 cm), and Ridomil gold (44.00 cm).

Number of branches plant^{-1}

The number of branches per plant was recorded after harvesting. During 2012-13, 2013-14, and 2014-15, the number of branches per plant ranged from 10 to 12 per plant. The data on the number of branch plant-1 did not show a significant difference among the treatments.

Number of pods plant^{-1}

The number of pods per plant was counted after harvesting. In the first and second years, the number of pods showed significant differences among treatments, and in the third year, the data for this character were not significantly different among treatments. In first year, the highest number of pods per plant was recorded from the plot treated by Rovral (159.3) followed by Dithane M-45 (155.7) and mahogany leaf extract (155.3). The lowest number of pods per plant was recorded from control (84.0), followed by datura leaf extract (118.7) and mahogany seed extract (122.3). In the second year, the highest number of pods (153.3) per plant was obtained from Rovral-treated plants, followed by Dithane M-45 and mahogany leaf extract (149.3). The lowest number of pods per plant was observed in the control (83.0), followed by garlic clove extract (109.7) and datura leaf extract (112.7). In the third-year field trial, the highest number of pods per plant was recorded in the plot treated with Rovral (155.3), followed by Dithane M-45 (149.7) and mahogany leaf extract (144.0). The lowest number of pods per plant was recorded from control (91.7), followed by datura leaf extract (112.3) and garlic clove extract (112.6).

Number seed pod^{-1}

The number of seeds per pod ranged from 1.8 to 2.0 across all treatments, comprising three years of data. The results did not show significant differences among treatments in 2012-13, 2013-14, and 2014-15.

Number seeds plant^{-1}

Throughout all three years, there was a significant variation ($p < 0.01$) in the number of seeds per plant across treatments. The control group had the lowest values (111, 101, and lowest in the third year), while Rovral consistently produced the greatest values (312, 302, and 269 seeds plant^{-1} in the first, second, and third years, respectively). Dithane M-45 (274) and Ridomil Gold (268) trailed Rovral in the first year, while Bavistin (256) and Ridomil Gold (258) trailed Rovral in the second. Rovral and Ridomil Gold performed similarly in the third year (269 seeds plant^{-1}), followed by datura leaf extract (205) and garlic clove extract (211). Chemical fungicides consistently outperformed botanical remedies. Overall, fungicidal treatments, particularly Rovral, significantly enhanced seed production per plant compared to the control.

Thousand grain weight (TGW)

TGW showed a statistical difference among the treatments during 2012-13 and 2013-14, but the 2014-15 result did not differ significantly. In first year the highest TGW was obtained from the plants treated by Cupravit (21.20 g) followed by Rovral (20.50 g) and Bavistin (20.00 g). The lowest TGW was recorded in garlic clove extract (17.60 g) followed by control (18.00 g) and Ridomil gold (18.00 g) treated plants. In the second-year field trial, the highest TGW was recorded for Rovral (17.40 g), followed by Cupravit (17.20 g) and cow urine (16.30 g). The lowest TGW was recorded from control (13.70 g) followed by Ridomil gold (13.90 g) and garlic clove extract (14.50 g) treated plants. In third year, field trial the highest TGW was recorded in Rovral (20.50 g) followed by Cupravit (19.90 g) and garlic clove extract (19.50 g) treated plants. The lowest TGW in that year was recorded in control (17.40 g) followed by mahogany leaf extract (17.90 g) and Ridomil gold (18.20 g).

Grain yield

Grain yield was expressed in ton per hector. The results of this parameter showed highly significant difference among the treatments. In first year, the highest grain yield was obtained from Rovral (2.79 t ha^{-1}) treated plants followed by fern leaf extract (2.37 t ha^{-1}) and Ridomil gold (2.32 t ha^{-1}). The yield obtained from datura leaf extract (2.19 t ha^{-1}), mahogany leaf extract (2.30 t ha^{-1}), neem leaf extract (2.18 t ha^{-1}), cow urine (2.26 t ha^{-1}), Dithane M-45 (2.28 t ha^{-1}) showed statistically similar results with fern leaf extract and Ridomil gold. During that year the lowest yield was obtained from control (1.10 t ha^{-1}) followed by garlic clove extract (1.54 t ha^{-1}) and mahogany seed extract (1.69 t ha^{-1}). In second year, trial the highest yield was performed by Rovral (2.07 t ha^{-1}) treated plants followed by Ridomil gold (1.75 t ha^{-1}) and fern leaf extract (1.68 t ha^{-1}). Yield obtained from the treatment mahogany leaf extract (1.65 t ha^{-1}), neem leaf extract (1.57 t ha^{-1}), fern leaf extract (1.68 t ha^{-1}), cow urine (1.63 t ha^{-1}), Dithane M-45 (1.64 t ha^{-1}) and Ridomil gold (1.75 t ha^{-1}) were showed identical results. The lowest grain yield was obtained from Control (0.85 t ha^{-1}). In third year, the highest yield was also performed by Rovral (2.13 t ha^{-1}) followed by fern leaf extract (1.92 t ha^{-1}) and cow urine (1.91 t ha^{-1}) treated plants. Yield of datura leaf extract (1.65 t ha^{-1}), mahogany leaf extract (1.74 t ha^{-1}), neem leaf extract (1.78 t ha^{-1}), Dithane M-45 (1.89 t ha^{-1}), Bavistin (1.73 t ha^{-1}), Cupravit (1.76 t ha^{-1}) and Ridomil gold (1.76 t ha^{-1}) treated plants gave identical results. In that year the lowest yield was performed by control (0.99 t ha^{-1}) followed by garlic clove extract (1.30 t ha^{-1}) and mahogany seed extract (1.51 t ha^{-1}).

Stover yield

The stover yield of lentil showed significant difference among the treatments in the field trial conducted during rabi 2012-13, 2013-14 and 2014-15. In first year, the highest amount of stover yield was recorded from the plants treated by Rovral (1.55 t ha^{-1}) followed by cow urine (1.45 t ha^{-1}) and Cupravit (1.40 t ha^{-1}). The lowest stover yield that year was obtained from the control, followed by the neem leaf extract-treated plants. In second year the highest straw yield was obtained from Rovral (0.85 t ha^{-1}) treated plants followed by cow urine (0.80 t ha^{-1}) and Cupravit (0.77 t ha^{-1}) plot. In that year, the lowest amount of straw yield was recorded from control (0.63 t ha-1) treated plants, followed by neem leaf extract (0.67 t ha^{-1}) and mahogany leaf extract (0.69 t ha^{-1}). During last year's field trial, the highest stover yield was obtained from both Rovral and cow urine-treated plants, and it was 0.91 t ha-1, followed by fern leaf extract (0.81 t ha^{-1}). In the same year, the lowest stover yield was recorded from control (0.60 t ha-1), followed by Cupravit (0.66 t ha^{-1}) and mahogany leaf extract.

Relationship of maximum and minimum temperature, relative humidity (RH) with plant disease index

In the field trial, PDI was recorded at 60, 70, 80, 90, and 100 days after sowing. PDI showed a linear positive relationship with maximum and minimum temperatures and relative humidity (RH). For minimum temperature with PDI, the linear equation was y = 2.018x + 20.07, with a regression coefficient R^2 = 0.754. In respect of the maximum temperature exhibited, the linear equation y = 3.91x + 20.07, with R2 = 0.879, and RH also exhibited a positive linear equation, y = 0.333x + 83.40, with R^2 = 0.120. The result indicated an increase in temperature, and RH is responsible for increasing disease severity by *Stemphyliumbotryosum* (Figure 4).

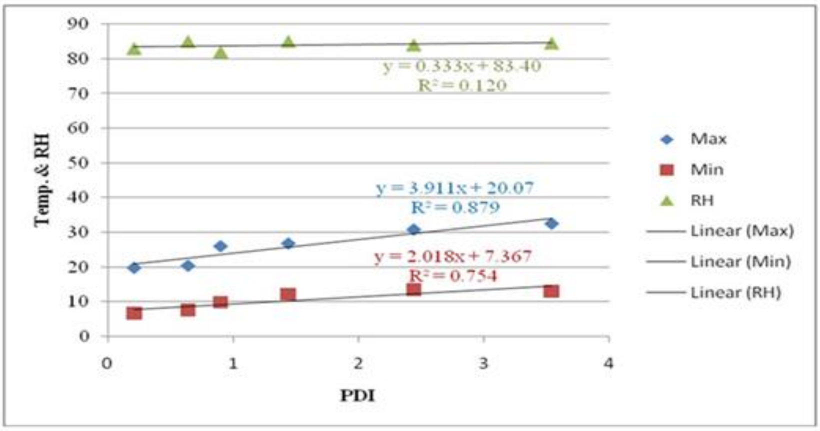

Figure 5. Relation among percentage relative humidity, maximum and minimum temperature, and Percent Disease Index (PDI)

Table 1. Effect of different chemicals and botanicals on plant population, plant height, branching and pod production of lentil

Treatments	Plant population m^{-2} (no.)			Plant height (cm)			Branch $plant^{-1}$ (no.)			Pod $plant^{-1}$ (no.)		
	1st year	2nd year	3rd year	1st year	2nd year	3rd year	1st year	2nd year	3rd year	1st year	2nd year	3rd year
Garlic extract	355	348	343	47.30	47.30	45.67	11	12	10	115.70c	109.70d	112.60
Datura leaf extract	352	340	334	48.00	47.00	47.00	11	11	10	118.70c	112.70d	112.30
Mahogany leaf extract	340	355	333	46.67	48.00	45.33	10	11	10	155.30a	149.30ab	144.00
Mahogany seed extract	354	349	338	45.67	46.70	44.33	10	11	11	122.30c	116.30d	117.00
Neem leaf extract	350	334	341	45.33	47.30	45.00	10	10	11	144.00ab	138.00bc	135.70
Fern leaf extract	355	351	341	50.00	49.00	43.00	12	10	11	148.00ab	142.00abc	139.70
Cow urine	344	348	342	49.70	48.70	43.67	11	12	11	146.70ab	140.70abc	144.00
Dithane M-45	337	330	336	47.30	46.70	45.00	10	10	12	155.70a	149.70ab	150.00
Bavistin	339	348	336	48.30	47.30	44.67	10	10	11	138.70b	132.70c	131.30
Cupravit	357	353	332	50.30	48.30	45.00	12	10	10	146.00ab	140.00abc	142.00
Ridomil gold	342	336	341	49.00	47.30	44.00	10	10	11	144.30ab	139.00abc	143.30
Rovral	353	342	328	49.30	47.70	43.67	12	10	10	159.30a	153.30a	155.30
Control	355	341	331	46.70	47.30	45.33	10	11	11	84.00d	83.00e	91.70
CV (%)	4.12	2.85	2.39	4.6	5.64	6.83	9.9	9.32	11.51	6.32	6.04	14.31
F-test	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*	NS

Means followed by the same letter(s) within a column do not differ significantly according to DMRT. NS = Not significant; * = Significant at 5% level of probability; CV = Coefficient of variation

Table 2. Effect of different chemicals and botanicals on seed yield and yield attributes of lentil

Treatments	Seed pod^{-1} (no.)			Seed plant^{-1} (no.)			1000 grain weight (g)			Yield (ton ha^{-1})			Stover yield (ton ha^{-1})		
	1st year	2nd year	3rd year	1st year	2nd year	3rd year	1st year	2nd year	3rd year	1st year	2nd year	3rd year	1st year	2nd year	3rd year
Garlic leaf extract	1.90	2.00	1.80	210ef	200ef	211d	17.60f	14.50def	19.50	1.54d	1.17e	1.30f	1.31bc	0.72bcd	0.76abc
Datura leaf extract	2.00	2.00	2.00	202f	192f	205d	18.50ef	15.10c-f	18.30	2.19bc	1.59cd	1.65d	1.31bc	0.71cde	0.77ab
Mahogany leaf extract	2.00	1.90	2.00	250bcd	240bcd	237bc	18.90ef	15.70bcd	17.90	2.30b	1.65bc	1.74d	1.31bc	0.69cde	0.69bc
Mahogany seed extract	1.90	2.00	2.00	228def	218def	223cd	18.00ef	15.20c-f	18.40	1.69d	1.23e	1.51e	1.31bc	0.70cde	0.72bc
Neem leaf extract	2.00	2.00	2.00	238cde	228cde	236bc	18.20def	15.30cde	18.40	2.18bc	1.57cd	1.78bcd	1.25c	0.67de	0.72bc
Fern leaf extract	2.00	2.00	1.90	247bcd	220def	234bc	19.70a-d	15.50cde	18.50	2.37b	1.68bc	1.92b	1.39bc	0.74bcd	0.81ab
Cow urine	2.00	2.00	2.00	263bc	253bc	234bc	19.50b-e	16.30abc	18.60	2.26b	1.63bc	1.91b	1.45ab	0.80ab	0.91a
Dithane M-45	2.00	1.90	2.00	274b	265b	255ab	18.60c-f	15.20c-f	19.00	2.28b	1.64bc	1.89bc	1.33bc	0.73bcd	0.79ab
Bavistin	1.90	2.00	2.00	266bc	256bc	267a	20.00abc	14.70c-f	18.50	2.04c	1.48d	1.73d	1.35bc	0.74bcd	0.79ab
Cupravit	2.00	1.90	2.00	249bcd	230bcd	251ab	21.20a	17.20ab	19.70	2.03c	1.47d	1.76cd	1.40bc	0.77bc	0.66bc
Ridomil gold	2.00	2.00	2.00	268bc	258bc	269a	18.00ef	13.90ef	18.20	2.32b	1.75b	1.76cd	1.38bc	0.76bc	0.71bc
Rovral	2.00	2.00	2.00	312a	302a	269a	20.50ab	17.40a	20.50	2.79a	2.07a	2.13a	1.55a	0.85a	0.91a
Control	2.00	2.00	2.00	111g	101g	103e	17.90ef	13.70f	17.40	1.10e	0.85f	0.99g	1.05d	0.63e	0.60c
CV (%)	4.21	4.21	3.58	7.53	8.08	5.42	4.43	5.58	5.28	4.07	4.20	4.66	6.33	4.96	10.97
F-test	NS	NS	NS	**	**	**	*	**	NS	**	**	**	*	*	*

Means followed by the same letter(s) within a column do not differ significantly according to DMRT. NS = Not significant; * = Significant at 5% level of probability; CV = Coefficient of variation

Conclusion

Under field conditions, lentil seedlings were found to be susceptible to soil-borne fungi at early growth stages, resulting in seedling mortality, particularly when stem tissues were tender. However, as the plants matured, especially after 30 days of sowing, the stems became hardened and less prone to fungal penetration. Among the plant extracts, cow urine, and chemical fungicides tested, Rovral 80WP (Iprodione group) was found to be the most effective in controlling Stemphylium blight and associated diseases and in increasing yield. Although several botanical extracts were effective in vitro, they were less effective under field conditions than chemical fungicides. The study also indicated that disease severity, expressed as Percent Disease Index (PDI), increased with increasing temperature and relative humidity, confirming that environmental factors play an important role in disease development. Based on the findings, Rovral 80WP can be recommended as an effective option for managing Stemphylium blight of lentil under field conditions. However, botanical extracts and cow urine showed moderate effectiveness and may be considered as eco-friendly alternatives in integrated disease management strategies to reduce reliance on chemical fungicides.

Conflicts of Interest

The authors declare no conflicts of interest.

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Data Availability

All data supporting the findings of this study are available from the corresponding author upon reasonable request.

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