



Vol. 3 No. 11 (November) (2025)

Assessment of Allelopathic Properties of Sorghum in Integration with Varying Rates of Seeding for Suppression of Weeds and Maize Yield Enhancement

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ABSTRACT

Weeds are uninvited plants that interfere with farming practices and degrade the quality of crops yield. Weeds are competing with cultivated crops plants for essential resources such as moisture, nutrients, sunlight, space, and carbon dioxide. Their rapid initial growth, especially in open fields, gives them a competitive edge. This study investigated the ability of sorghum extracts from both immature and mature plants to influence the growth of other organisms at varying seeding rates for their impact on weed count (m^{-2}) and the yield of the maize variety Dadu Maize-I. This study comprised multiple weed management strategies, including a control (no weeding), utilization of sorghum plant extracts at 15 Litters per ha (both immature and mature) alone, and in combination with a reduced herbicide dose at 1 Litters per ha, along with manual weeding twice. These treatments were applied under different maize seeding rates (20, 25, 30, & 35 kg per ha). Statistical analysis revealed that different weeds controlling strategies significantly



Vol. 3 No. 11 (November) (2025)

reduced weed infestation, thereby enhancing kernel yield. The most effective treatment was the application of immature sorghum extract at 15 Litters per hectare combined along decline herbicide rate (1 Litters per ha), which significantly lowered weed count (m^{-2}), and increased weed mortality (%), ultimately improving maize growth and kernel yield (kg per ha). The second-best treatment was mature sorghum extract at 15 Litters per ha with a herbicide dose of 1.0 Litters per ha, where weeds were effectively suppressed and kernel yield was enhanced. Regarding seed rates, the lowest weed count (m^{-2}) and highest kernel yield (kg per ha) were recorded at 35 kg ha⁻¹; however, the optimal kernel yield (kg per ha) was achieved at 30 kg per ha. These findings suggest that integrating sorghum plant extracts with a decline herbicide dose is an effective weed management approach, and a maize seed rate of 30 kg per ha is ideal for maximizing kernel yield.

Keywords: Sorghum Extract, Allelopathic Effect, Seed Rates, Weeds, Kernel Yield

Introduction

In Pakistan, maize (*Zea mays* L.) holds the third position in ranking, following rice and wheat. It is a vital crop grown in both autumn and spring seasons. Often referred to as the "Queen of Cereals" maize is recognized for its high efficiency and adaptability (Kumar et al., 2017). Among other variables capable for surrender lessening in maize, weed invasion is the foremost vital calculate decreasing maize abdicate from 24 to 83 percent Dogan et al. (2004) similarly (Fahad et al., 2014; Arif et al., 2013) suggested to suppress of weeds is the foremost vital calculate for agricultural economic. Decreased of crop yield because of disease, insects and weeds (Ihsan et al., 2015) and (Hassan et al., 2019) Corn yield might be decreased around 32 percent because weeds compete (*Trianthema portulacastrum* L.) invasion up to 80 percent because competition from ryegrass (*Lolium rigidum*) infestation level varying on the time (Izquierdo et al., 2003). The most aggressive weeds commonly found in maize fields in Pakistan include purple nutsedge, Bermuda grass, and horse purslane. Interface (Mehmood, 2009). The prevalence and weeds competitive capacity with crop changes due to variety planted supplements accessibility, soil condition and management of soil. Herbicides non-judicious utilization can be made eco-friendly and associated with health problems generally in adding to resistance weeds growth (Jabran et al., 2018). Naturalists are profoundly involved with the uncritical utilization of herbicide. Newly species of weeds developed challenges glyphosate, in glyphosate resistance crops, spread many countries of the world infestation several crops and weed conditions (Heap & Duke, 2018), develop obscure and substitute weed suppress procedures are crucial. Indiscriminate herbicides use driven agro-ecosystem towards declining species diversity in various conditions & increasing herbicide resistant (Powels and Yu, 2010; Safdar et al., 2014). Therefore, the application of allelochemicals of allelopathic plants offers encouraging prospects for environmental weed control (Lorenzo et al., 2013).

Allelopathy may in this way an alternative to synthetic herbicides is using natural or organic methods for weed control. Since allelopathic compounds do not have residue effects (Bhadoria, 2011). Allelochemical compounds found in various crops sorghum (Weston & Duke, 2003), Parthenium and Sunflower (Hassan et al., 2018; Safdar, 2014) they repressive as well as stimulatory to weeds at small quantities. The earlier research suggested by Cheema et al. (2013) utilization of allelochemicals for enhancing crop production in Pakistan are successful. Similarly reported Khan et al. (2020). Furthermore, detected that allelopathic effects carry out a single complex, but, if possible, interface of various composites could work collectively any in synergetic or



Vol. 3 No. 11 (November) (2025)

means preservative (Putnam et al., 1983). Even though allelopathic compounds cannot completely weeds control may be apply combined herbicides to use for control weeds in crops in field (Korejo et al., 2021). It is challenging to achievements of allelopathic properties which par with herbicides efficiency, however herbicides use can be decreases the combination of allelopathic compounds & herbicide are helpful (Jabran et al., 2018). The ecological reliability combined corn cultivars with decrease rate of herbicide Atrazine effectively weeds controlled and harvested noticeable equivalent yield with the suggested dose of Atrazine (Hassan et al., 2019).

A higher seed rate is a key strategy that enhances populations of crop plants and improves crop ability against weeds. A high seeding rate typically results in a dense plant stand, enabling crops to compete effectively with weeds and is most effective source of weed management in crop (Chauhan & Johnson, 2011). High seed rates is needed to ensure an optimum and efficient inhabitant for improved yield is anticipated, along with a reduction in growth of weeds. Weed control with enhancing crop plants and spatial uniformity in field crop (Olsen et al., 2005 & 2006). This infers that expanded trim density had solid reliable negative impacts on weeds biomass and effects positive on yield of grain and yield of straw. Gill (2008) stated that higher seeding rates promote rapid canopy closure, which effectively suppresses weed growth. Another earlier researcher Korejo et al. (2021) and Chauhan (2020). Highlight that enhancing crop competitiveness is a crucial objective in weed management strategies. This can be achieved by optimizing crop spacing, maintaining an appropriate seed rate, modifying sowing methods, selecting weed-suppressive varieties, and ensuring efficient use of water and nutrients.

MATERIALS AND METHODS

To evaluate weed suppression and enhance maize kernel yield through the sorghum plants allelopathic extracts combined with different seeding rates, research was conducted at the Cotton Research Institute, Agriculture Research Center, Tandojam, Pakistan, during the spring seasons of 2019 & 2020. The experiment was designed using a randomized complete block design (RCBD) with a factorial arrangement, three replications while net plot size 5×4 meters (20m²). Dadu Maize-I. Was the variety chosen for sown. The seeding rates of different used for example (20, 25, 30 & 35 kg per hectare) were tested under different weed management approaches. These including control (no weeding) the application of sorghum plant extract at 15 litters per hectare, either alone or combined with a declined rate of herbicide at 2 litters per hectare, and manual weeding conducting twice. The soil was classified as silty clay loam, characterized by low nitrogen content (0.021%), limited organic matter (0.42%), & a high pH of 8.24. Nitrogen Phosphorus and potassium were applied were recommended kg per hectare in the form of DAP

Weeds and crop observations

Weed count (m⁻²): Weed count was recorded at 60 DAS using a one-square-meter wooden frame to determine the total weed density per square meter.

Weed count (m⁻²) = Total Number of weeds (m⁻²) for given treatment
No. of replications

Weed mortality (%): check weed density–given treatment weed density x 100.
Check weed density.



Vol. 3 No. 11 (November) (2025)

Plant height (cm): Plant height (cm) was recorded using a measuring tape, measuring from the plant's base to the point where tassel branching starts.

Cob length (cm): Cob length was noted in centimetre (cm) from the base of cob to its tip.

Kernel wt. (g cob⁻¹): Maize Seeds of each selected plant was weighted separately and average was calculated.

Kernel yield (kg ha⁻¹): Kernel yield (kg ha⁻¹) = $\frac{\text{Yield plot}^{-1} \times 10000}{\text{Area of plot (m}^2\text{)}}$

Kernel protein content (%): The protein content was determined by multiplying the nitrogen value by a conversion factor of 6.25 mg.

Metrological data

Meteorological data for Tandojam during the two experimental years (2019 & 2020) Data were gathering from the meteorological observatory at DRIP, Tandojam. Monthly records for February to May, including temp., (°C), rainfall (mm), & humidity (%), are shown in Figure. 1.

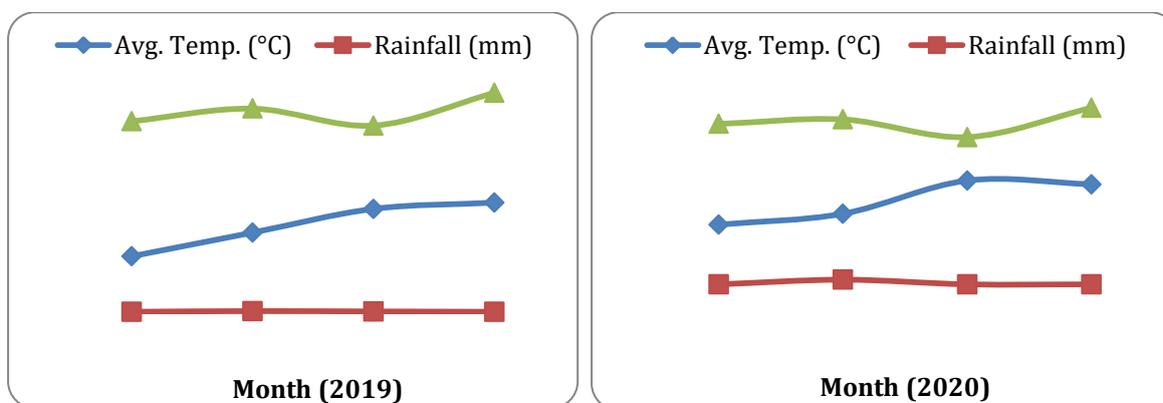


Figure. 1. Weather data for Tandojam during the 2019 & 2020 cropping seasons.

RESULT & DISCUSSIONS

Weed count (m⁻²)

Weed management strategies had a significant impact on weed count (m⁻²) in maize contrasted with (control) no-weeding treatment (Table 1). The lowest weed count (63.6 m⁻²) was noted with the utilization of sorghum immature plant extract at 15 Litters per ha combined with herbicide (Mesotrione Atrazine) at 1.0 L ha⁻¹. This was subsequently the combination of mature sorghum plant extract at 15 Litters per ha and herbicide at 1.0 L ha⁻¹, which resulted in a weed count of 81.9 m⁻². The highest weed count (175.5 m⁻²) was observed in the control treatment. Among seeding rates also had a significant impact on weed count. The lowest weed count (111.2 m⁻²) was noted at a seed rate of 35 kg ha⁻¹, subsequently by 30 kg ha⁻¹ with 115.6 m². Weed counts of 120.3 m⁻² and 124.2 m⁻² were noted at seed rates of 25 kg ha⁻¹ & 20 kg ha⁻¹, respectively. The results shows in (figure-1) A substantial interaction between weed control practices and seed rates was recorded



Vol. 3 No. 11 (November) (2025)

in relation to weed count m^{-2} . These findings align by those of Cheema et al. (2004), who suggested that sorghum releasing of various allelochemical compounds that impact the growth of surrounding plant species and influence seed germination (Hozayn et al., 2011). Allelopathic crops extract application in mixture with decreased herbicides essentially repressed the weeds count (Farooq et al., 2013) and (Afridi and Khan, 2014; 2015). The reduction in weeds population using a combination of herbicide at 33% declined dose along with allelopathic extracts from various crops like Brassica, Sunflower, and Sorghum has also been suggested by Iqbal et al. (2010). These findings are related to previous researchers Iqbal et al. (2007) who asserted that extracts of allelopathic plants with combined compact dose of glyphosate decrease population of (*C. rotundus* L.) by 59-99%. Weed density was reduced by 19% to 49% through the use of allelopathic plants (Arce et al., 2009; Korejo et al., 2021). An increased seeding rate enhances crop ability against weeds (Chauhan & Johnson, 2011). Higher seed rates led to a reduction in weed count (m^2). The decrease in weeds population with increasing seeding rates could be attributed to contesting from crop plants for space, moisture, sunlight & nutrients (Jhala et al., 2008).

Weed mortality (%)

The statistical analysis of variance indicated that immature and mature sorghum plant extract caused significantly on weed mortality (%) the data discovered that sorghum immature & mature plant extract @ 15 Litters per hectare along to herbicide declined dose 1 Litter per ha exerted highly significantly effect on weed mortality % resulted in maximum 64.5 % recoded followed by combined application of sorghum mature plant extract and decreased rate of herbicide at 1.0 L ha^{-1} 53.8 was noted. Among seed rates, the highest weed mortality (40.3 %) was record in seed rate 35 $kg ha^{-1}$ while seed rate 30 $kg ha^{-1}$ ranked 2nd in effectiveness resulted in 38.8 % weed mortality. As regards interaction (figure 2) maximum weed mortality % was recorded in interaction between W_6 and seed rates S_4 35 $kg ha^{-1}$. The results of our study link with previous studies. The most noteworthy weeds percent of mortality coordinates use of extracts with herbicide the enhancement in phytotoxic adequacy of sunflower and sorghum plants. Allelopathic crops extracts used higher concentration-controlled weeds count and weight. Allelochemicals at higher concentration can interfere with hormone production, inhibit cell division, and disrupt nutrient uptake and mineral transport (Kandhro et al., 2015; Mohammed et al., 2020). Allelopathic extracts, in combination with a lower herbicide dose, have shown effective control over problematic weeds for crops in field conditions (Cheema et al., 2013). Equally, (Nouri et al., 20112; Cheema et al., 2004) discovered that foliar treatment of sorghum plant noticeably declined weeds 18 to 50 percent and showed most economical. Increasing the seed rate is a key strategy for enhancing plant density and improving crop competition ability against weeds. A higher seeding rate typically results in a denser plant stand, enabling the crop to better suppress weed growth. This approach is recognized as an effective weed management technique in crops (Chauhan & Johnson, 2011).

Plant height (cm)

The data revealed that maximum plant height (217.7 cm) was noted under immature sorghum plant extract at L ha^{-1} along with decline rate of herbicide (Mesotrione Atrazine) at 1 L/ha while mixture applied of mature sorghum plant extract at 15 L/ha + 50% decline dose of herbicide (Mesotrione Atrazine) at 1.0 L ha^{-1} resulted in 211.2 cm and least (171.4 cm) plant height noted in no weeding control. As regards seed rates highest plant



Vol. 3 No. 11 (November) (2025)

height 200.3 cm in seed rate 35 kg ha⁻¹ while seed rate 30 kg ha⁻¹ ranked 2nd by giving 197.8 cm and lowest plant height in the seeding rate of 20 kg ha⁻¹ resulted in 193.4 cm was observed. As regards interaction (figure 3) maximum weed mortality % was recorded in interaction between W₆ and seed rates S₄ 35 kg ha⁻¹. These results are demonstrated that sorghum extract applied as sole in or integrated with decreased rate of herbicide for suppressed weeds and established conducive environmentally friendly for better development of crop. The conclusions of this study linked with (Khan et al., 2020; Iqbal et al., 2007) results of past study work to sorghum. Allelopathic plant extract control weeds efficiently and enhanced crop development such as plant height. Seed rate had a significant impact on plant height, showing a general trend of increased height with higher seed rates (Hayat et al., 2018). Similarly, Snider et al. (2012) suggested a comparable effect of seeding rate on plant height.

Cob length (cm)

The data presented in (Table 1) indicate that weed control practices had a significant impact on cob length. The combination of immature sorghum plant extracts at 15 Litters per ha along with herbicide declined rate (Mesotrione Atrazine at 1 Litter per ha) resulted in the longest cob length of 24.8 cm. This was subsequently the integration of sorghum mature plant extract at the same rate with herbicide, producing a cob length of 23.0 cm. In contrast, the shortest cob length (17.3 cm) was recorded in the no-weeding control. Additionally, seed rates significantly influenced cob length. The longest cob (22.3 cm) produces under seed rate of 20 kg ha⁻¹, subsequently seeding rate of 25 kg ha⁻¹ & 30 kg ha⁻¹, which resulted in cob lengths of 21.0 cm and 20.3 cm, respectively. The shortest cob length (19.7 cm) was observed at a seed rate of 35 kg ha⁻¹. Furthermore, the interaction between wcp., and seeding rates was noted to be significant in determining cob length (figure-4). The earlier researcher also reported that planting density had a considerable effect on cob length (Amiri et al., 2014). The length of cob decreased as the weed interference period extended. The enhance in cob length at lowest plants population should be attributed to declined competitions for energy and nutrients, allowing plants to channel more resources into photosynthesis and sink development (Sharifi et al., 2009). Overall, lower plant density resulted in greater cob length across maize. Earlier studies have also highlighted considerable differences among maize genotypes in yield traits, which are influenced by their genetic potential and crop management practices, particularly plant population (Stansluos et al., 2024). Higher plant populations intensify competition among plants for light, water, and nutrients, which negatively affects maize growth and the development of reproductive organs (Iqbal et al., 2021). However, it has been suggested that higher plant densities may negatively impact grain yield by promoting apical dominance, leading to barrenness and ultimately reducing the kernel set ear⁻¹ (Stansluos et al., 2024). Findings also indicated that an increase in plant density gradually decreased cob length (Konuskan et al., 2022).

Kernel wt. (g)

The data on kernel weight (g) revealed a significant impact of weed control methods. The combination of sorghum immature plant extracts at 15 Litters per ha along with herbicide declined rate (Mesotrione Atrazine at 1 Litter ha) resulted in the highest kernel weight of 220.3 g. This was subsequently the combination of mature sorghum plant extract at the same rate with herbicide, which produced 198.5 g. In contrast, the lowest kernel weight (67.4 g) was observed in the no-weeding control. Seed rates also had a notable effect on kernel weight. The highest kernel yield weight (150.6 g) noted under seed rate seed rate



Vol. 3 No. 11 (November) (2025)

of 20 kg ha⁻¹, subsequently by seed rate of 25 kg ha⁻¹ & 30 kg ha⁻¹, which resulted in kernel weights of 138.8 g and 127.4 g, respectively. The lowest kernel weight (119.1 g) was noted at a seed rate of 35 kg ha⁻¹. Furthermore, the interaction between wcp and seeding rates was noted to be substantial for kernel weight. These discoveries are linked with recent results of Khan et al. (2020) who interpreted that herbicide and allelopathic material substantially enhanced kernel weight. The study shows that valuable role of seed rates in integrated with several weed suppresses practices for a contained method for regulating weeds in field crop. Enhanced crop plant population and utilization of herbicide are two vital factors of (IWM) integrated weed management system. These results emphasize the significance of optimal plant density and high-yielding genotypes for the sustainable production of nutritionally rich kernel maize (Shah et al., 2021). Similarly, these findings align with those of Iqbal et al. (2021) who reported that higher plant populations negatively impacted maize yield components by reducing the number of kernels cob⁻¹ and kernel weight (Gozubenli et al., 2004). Additionally, an increase in plant population has been reported to lead to higher plant sterility, extend the interval between male and female flowering, and decrease the number of grains per ear (Konuskan et al., 2022). Findings also indicated that as plant density increased, kernel weight gradually decreased (Konuskan et al., 2022).

Kernel yield (kg ha⁻¹)

The statistical analysis of variance demonstrated that various weed control treatments substantially enhanced maize kernel yield compared to control (no-weeding). The combination of immature sorghum plant extract at 15 Litters per hectare with herbicide declined rate (Mesotrione Atrazine at 1 L/ha) resulted in the highest kernel yield (6803 kg ha⁻¹), subsequently the combination of mature sorghum plant extract at the same rate with herbicide, yielding 6426 kg ha⁻¹. In contrast, the lowest kernel yield (4156 kg ha⁻¹) was noted under the no-weeding control. Seed rates also had a significant effect on kernel yield. The highest yield (5878 kg ha⁻¹) was observed at a seed rate of 35 kg ha⁻¹, subsequently 25 kg ha⁻¹ and 30 kg ha⁻¹, producing 5687 kg ha⁻¹ and 5580 kg ha⁻¹, respectively. The lowest kernel yield (5371 kg ha⁻¹) was observed at a seed rate of 20 kg ha⁻¹.

Table 1. Effects of weed control practices and seeding rates on weed attributes and maize traits

WCP	Weed Count (m ⁻²)	Weed Mortality (%)	Plant Height (cm)	Cob Length (cm)	Kernel wt. (g cob ⁻¹)	Kernel Yield (Kg ha ⁻¹)	Kernel Moisture Content (%)
No weeding	171.5 A	0.0 G	171.4 G	17.3 G	67.4 G	4156 G	4.9 G
SIPE (15 L ha ⁻¹)	136.1 C	24.4 E	191.2 E	19.7 E	96.6 E	5271 E	6.0 E
SMPE (15 L ha ⁻¹)	154.0 B	11.7 F	181.2 F	19.2 F	80.4 F	4843 F	5.6 F
Herbicide (2 L ha ⁻¹)	99.9 E	43.3 C	205.6 C	21.5 C	152.4 C	6141 C	8.6 C
HW (30 & 55 DAS)	118.0 D	32.7 D	200.1 D	20.2 D	122.3 D	5763 D	7.1 D
SIPE (15L ha ⁻¹) + Herbicide (1 Lha ⁻¹)	63.6 G	64.5 A	217.7 A	24.8 A	220.3 A	6803 A	9.5 A



Vol. 3 No. 11 (November) (2025)

1)							
SMPE (15L ha ⁻¹) + Herbicide (1 Lha ⁻¹)	81.9 F	53.8 B	211.2 B	23.0 B	198.5 B	6426 B	8.9 B
Mean	-	-	-	-	-	-	-
Seeding Rates							
S ₁ = 20 kg ha ⁻¹	124.2 A	35.9 C	193.4 D	22.3 A	150.6 A	5371 D	6.8 D
S ₁ = 25 kg ha ⁻¹	120.3 B	37.8 BC	196.2 C	21.0 B	138.8 B	5580 C	7.1 C
S ₁ = 30 kg ha ⁻¹	115.6 C	38.8 AB	197.8 B	20.3 C	127.4 C	5687 B	7.4 B
S ₁ = 35 kg ha ⁻¹	111.2 D	40.3 A	200.3 A	19.7 D	119.1 D	5878 A	7.7 A

Variables	Weed Count (m ⁻²)	Weed Mortality (%)	Plant Height (cm)	Cob Length (cm)	Kernel wt. (g cob ⁻¹)	Kernel Yield (Kg ha ⁻¹)	Kernel Moisture Content (%)
WCP	2)						
S.E	0.2406	0.0386	0.4201	0.3014	2.0104	0.0339	0.0205
L.S.D	0.4960**	1.9219**	1.0511**	0.5241** *	6.0101**	0.0570** *	0.0415**
Seeding Rates							
S.E	0.1770	0.5428	0.3046	0.2207	2.0154	0.0256	0.0155
L.S.D	0.3100**	1.4528**	0.7071**	0.0081**	4.2010**	0.0415** *	0.0311** *

Additionally, the interaction between weed control treatments and seed rates showed a significant influence on kernel yield (kg ha⁻¹). Seed yield in various crops has been reported to increase by 15-25 percent (Cheema et al., 2013). These results align with those of Stougaard and Xue (2004), who emphasized that planting density plays a crucial role in suppressing weed growth and improving grain yield. Raising the seeding rates from 175 plants m⁻² - 280 plants m⁻² resulted in a 12% increase in crop production. In previous study Amiri et al. (2014) suggested that higher plant density not only enhanced economic yield but also suppressed the developments of competing plants. Likewise, Gozubenli et al. (2004) found that enhanced kernel yield with plant population. Similarly, Konuskan et al. (2022) also indicated that higher seed rates helped suppress the growth of weeds while enhancing grain yield. Additionally, Mohammad et al. (2020) noted that increasing the seeding rate by 50% led to a 26% rise in crop yield.

Protein content (%)

The statistical analysis of variance demonstrated that different weed control practices had a significant impact (p<0.05) on the protein content (%) of maize. The highest protein content (9.5%) was recorded with the utilization of 15 L ha⁻¹ of mature and immature sorghum plant extract combined with 1.0 L ha⁻¹ of the herbicide Mesotrione Atrazine was subsequently the combined use of mature sorghum plant extract at the same rate with the herbicide, leading to an 8.9% effect. The lowest protein content (4.9%) was observed in the no-weeding treatment. Seed rates also influenced protein content, with the 35 kg ha⁻¹ seed rate yielding the highest protein content (7.7%) contrast to other seed



Vol. 3 No. 11 (November) (2025)

rates, such as 20 kg ha⁻¹ (6.8%), 25 kg ha⁻¹ (7.1%), & 30 kg ha⁻¹ (7.4%). Furthermore, the interaction between weed control methods and seed rates showed a significant effect on protein content (%). These findings are aligned with earlier study suggested that the combination of plant extracts with a declined rate of herbicide efficiently controlled weeds while enhancing maize growth and yield (Khaliq et al., 2012). The significant enhancing in seed protein content was attributed to reduced competition between crops and weeds for vital resources. As a result, minimizing crop-weed competition led to overall enhanced crop growth, as evidenced by increased plant height and dry matter accumulation. This, in turn, contributed to better reproductive structure development and efficient translocation of photosynthates to the sink (Hua et al., 2025). These findings align with previous studies, which reported that grain protein content is significantly influenced by agronomic management practices and genetic variations (Pixley & Bjarnason, 2002). Our findings are consistent with those of Widdicombe and Thelen (2002), who reported a decline in crude protein content in forage maize as plant density increased. Conversely, JiWang et al. (2004) found that crude protein content enhanced with higher plants population. Overall, most studies indicate a general trend of reduced grain protein percentage with increasing plant density across various genotypes (Al-Naggar et al., 2016).

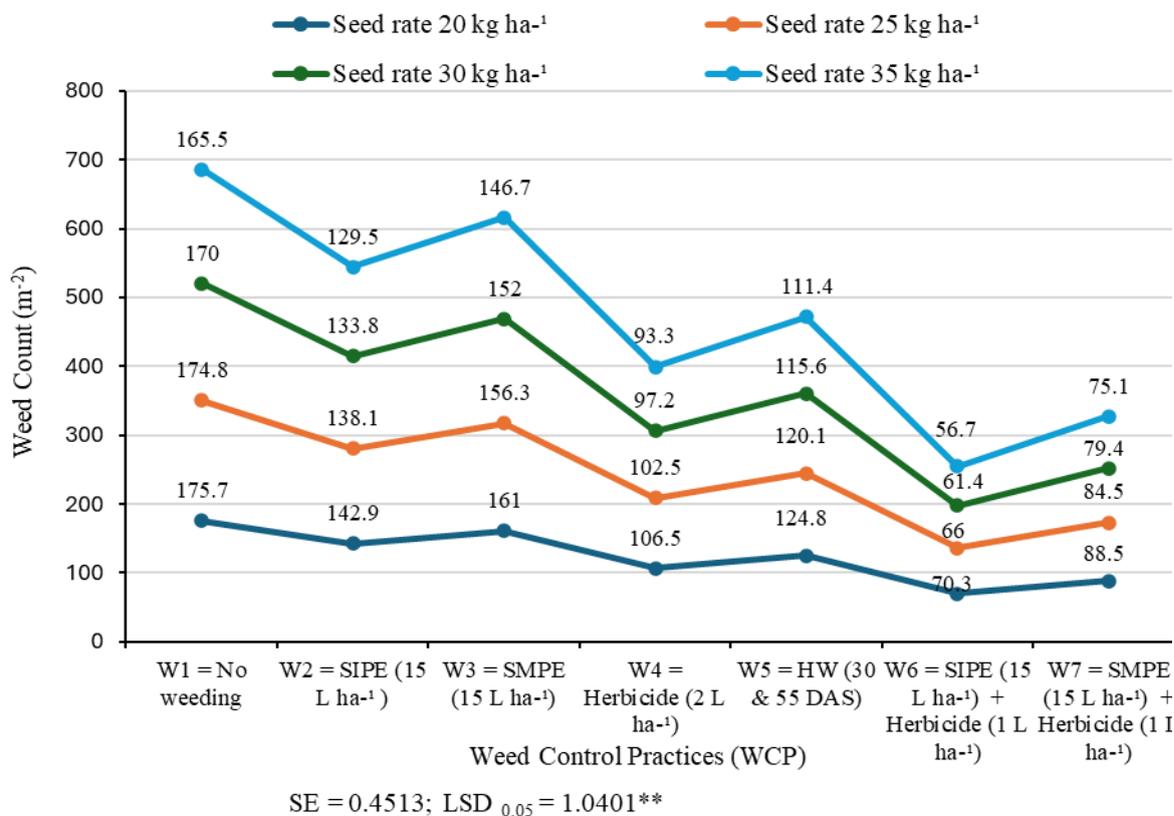


Figure. 1. Interactive effect of weed control practices × seed rates on weed count (m⁻²)

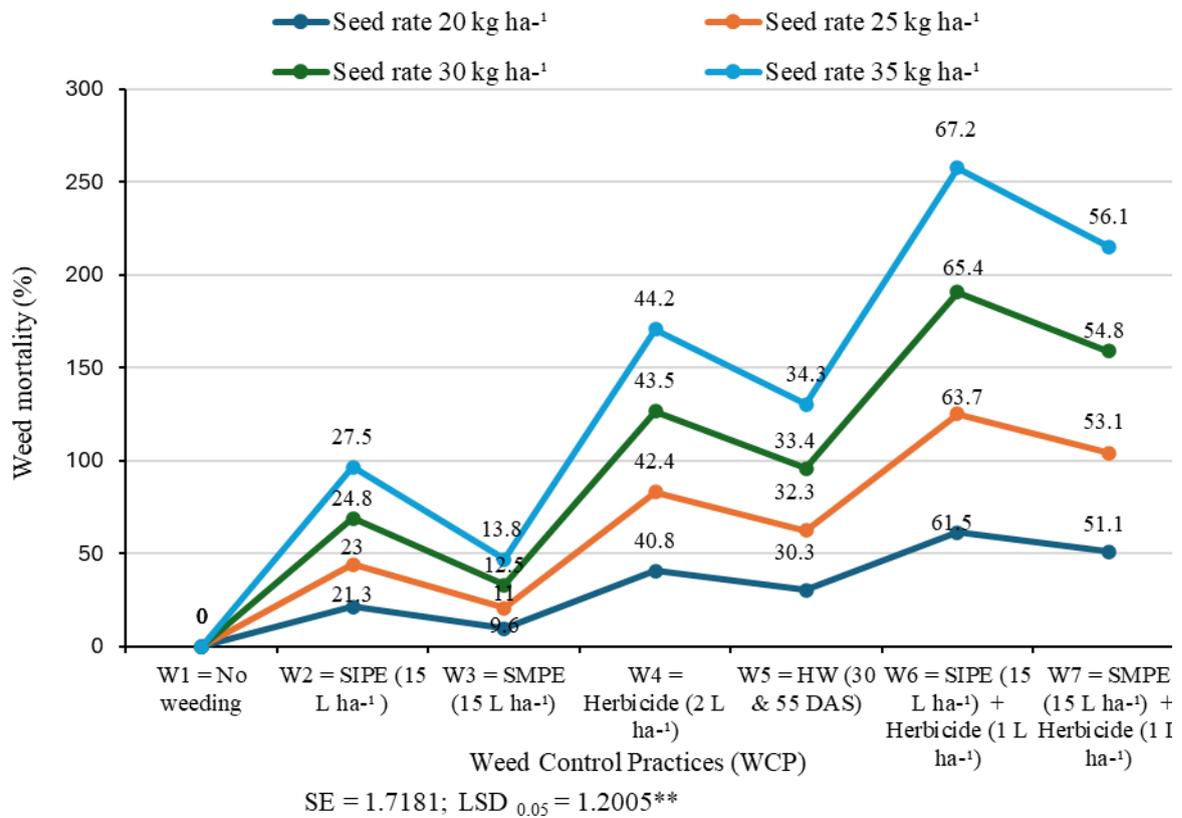


Figure. 2. Interactive effect of weed control practices × seed rates on weed mortality (%)

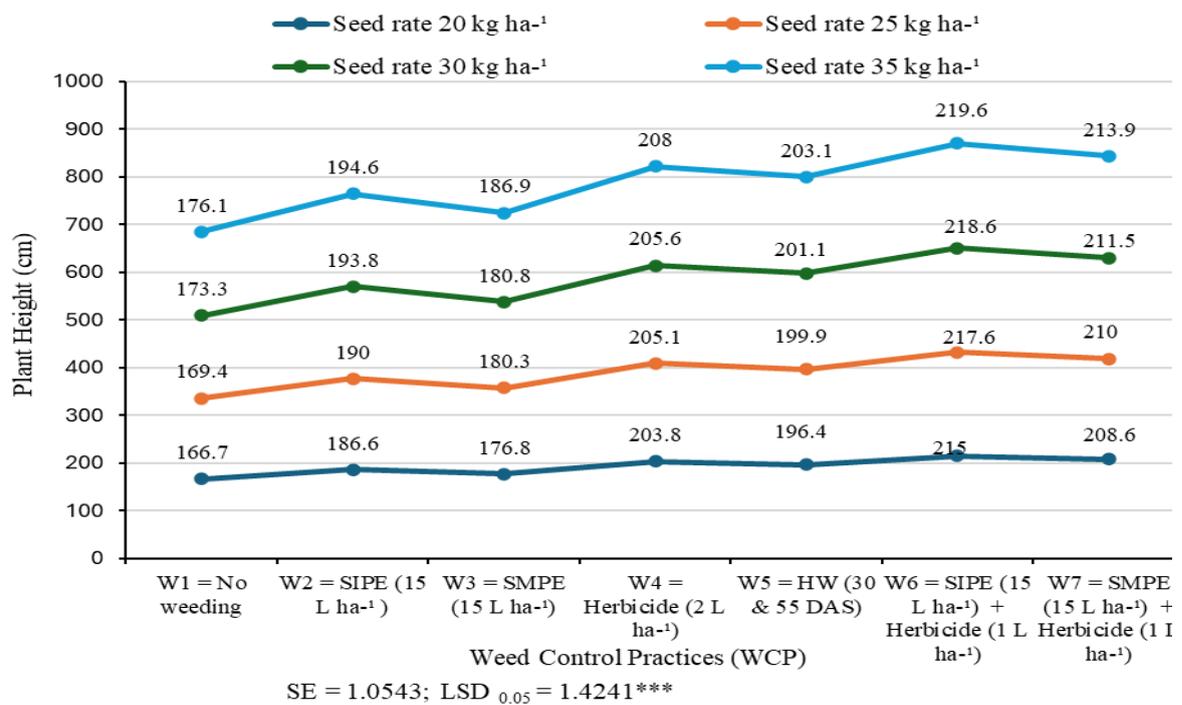


Figure. 3. Interactive effect of weed control practices × seed rates on plant height (cm)

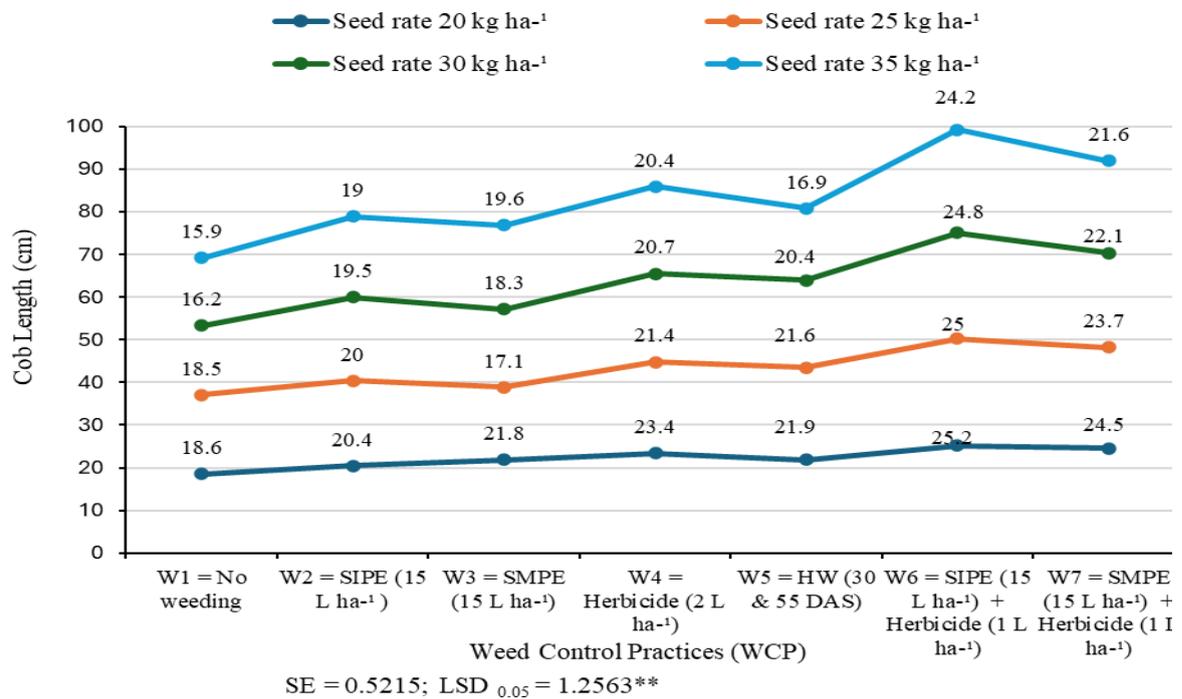


Figure. 4. Interactive effect of weed control practices × seed rates on cob length (cm)

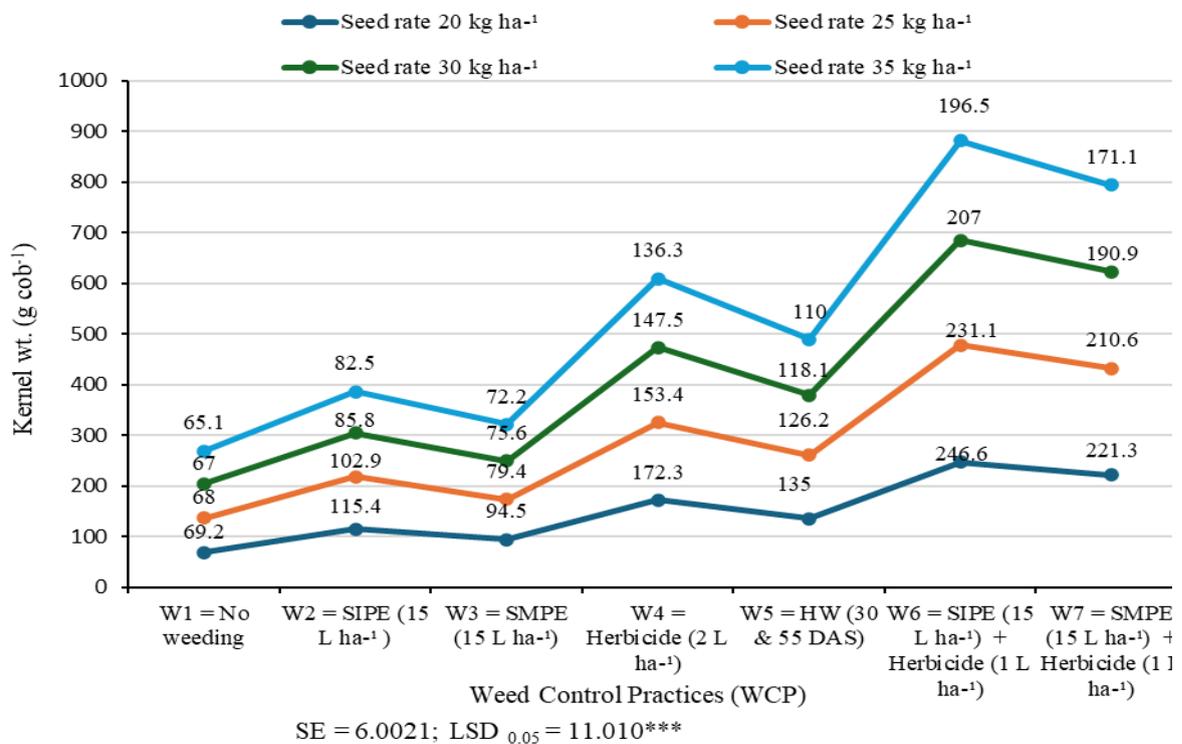


Figure. 5. Interactive effect of weed control practices × seed rates on kernel wt. (g cob⁻¹)

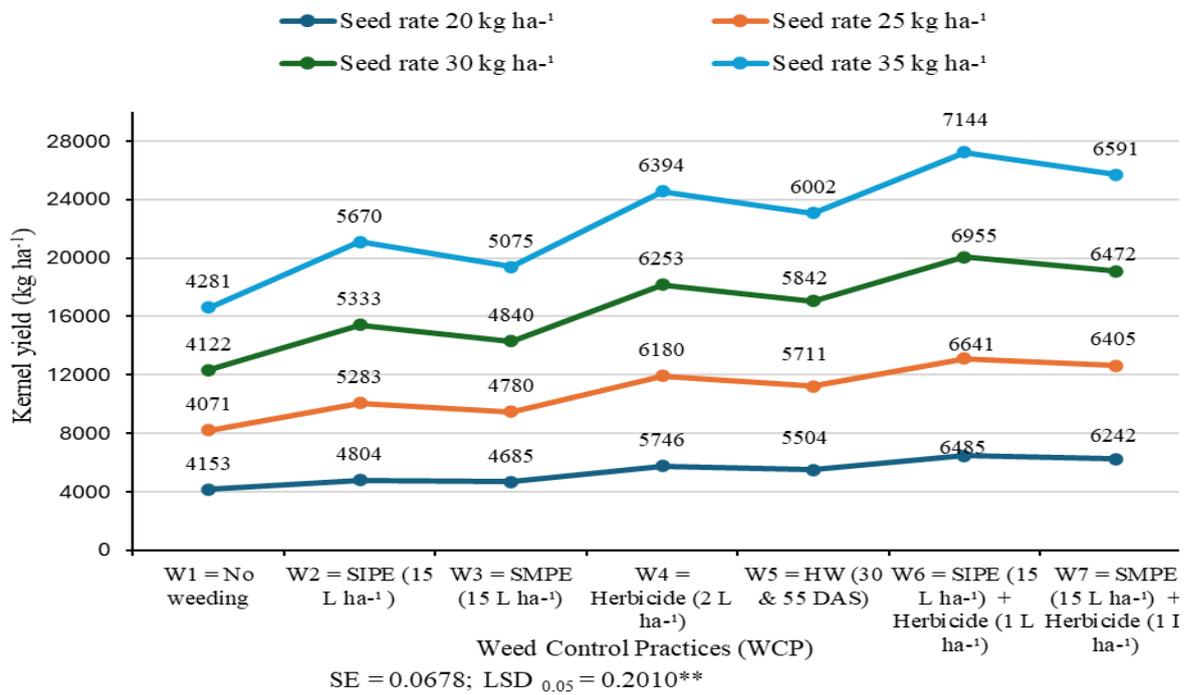


Fig. 6. Interactive effect of weed control practices × seed rates on kernel yield (kg ha⁻¹)

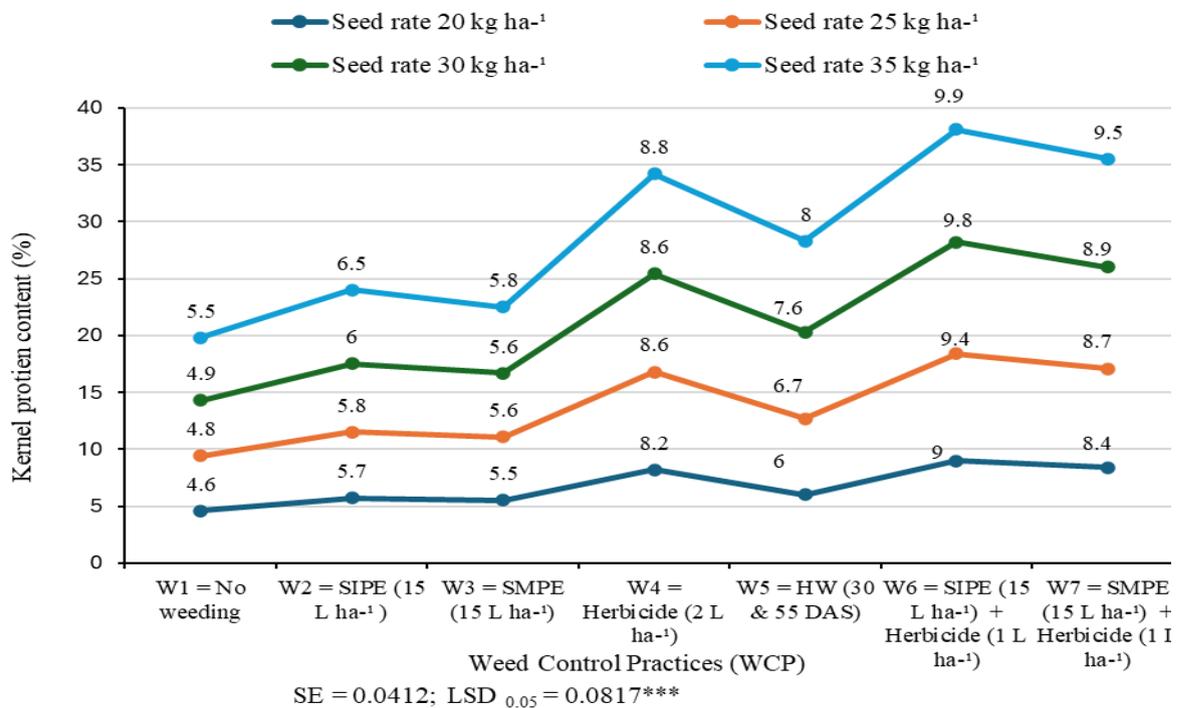


Fig. 7. Interactive effect of weed control practices × seed rates on kernel protein content (%)

Conclusions

The findings of this study suggest that the utilization of immature and mature sorghum plant extract at 15 Litters per hectare along with a 50% declined rate of herbicide (Mesotrione Atrazine at 1.0 Liter per hectare) effectively weeds controlled & significantly kernel yield of maize was increased. Among the different seed rates, 30 kg ha⁻¹ proved to



Vol. 3 No. 11 (November) (2025)

be the most suitable for weed suppression and achieving optimal maize kernel yield. This approach not only enhances crop productivity but also promotes sustainable weed management by reducing reliance on synthetic herbicides. Additionally, the integration of sorghum plant extracts with decline herbicide doses can contribute to environmentally friendly agricultural practices while maintaining high yield potential.

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Vol. 3 No. 11 (November) (2025)

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Vol. 3 No. 11 (November) (2025)

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Vol. 3 No. 11 (November) (2025)

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