

On Farm Evaluation of Portable Gun Type Sprinkler Irrigation on Wheat Crop

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ABSTRACT

Wheat production, with gun sprinkler systems showing promise for increasing yields and water use efficiency compared to surface irrigation methods. The aim of this study was to evaluate portable gun sprinkler irrigation on wheat crop at Doddota district of Arsi zone. The effect of different operating pressure (250kpa, 300kpa and 350kpa) and riser height (1.5m, 2m and 2.5m) on discharge, application rate, radius of throw, coefficient of variation was checked for determining optimum operating condition that achieve high distribution uniformity and wheat production in the study area. The wheat yield was affected by distribution uniformity of gun sprinkler under combined effect of operative pressure and riser height. Accordingly, the highest distribution uniformity 97.2%, yield 5.590t/ha, grain yield 3.823t/ha, water use efficiency 0.77m³/kg and irrigation water use efficiency 0.92m³/kg was obtained under combined effect of 350kpa and 2m riser height. Therefore, for similar agro-climatic condition like Doddota using gun sprinkler with nozzle size of 12mm under operating condition of 350kpa and riser height 2m was recommended for obtaining higher distribution uniformity and wheat yield.

Keywords: Gun Sprinkler Irrigation; Operating Pressure; Riser Height; Distribution Uniformity; Water Use Efficiency; Irrigation Water Use Efficiency; Grain Yield.

1.0. Introduction

Water resources are plentiful in Africa, but they are misused and dispersed unevenly over the continent. Concerns about water quantity and quality are significant stressors in agricultural water management (AWM), despite the fact that cross-sectoral rivalry brought on by urbanization and industrial growth is increasing localized use and stressing water sources (African Union, 2020).

In many regions of Sub-Saharan Africa (SSA), crop production continued without properly integrating appropriate and efficient technology throughout the crop production value chain (Oke et al., 2022). Ethiopian agriculture both contributes to and suffers from water scarcity, and the problem will only worsen as agricultural demand rises in the future. Surface irrigation has always been a widespread technique throughout the nation. Water loss during transportation occurs in surface irrigation. The primary causes of this water conveyance loss are evaporation, operation losses, and soil percolation from the sloping surfaces and canal bottom (Oke et al., 2022a).

The increasing water stress and sustainable farming technologies are addressed with a variety of tactics and solutions. Water Conservation and Saving Technologies (WCSTs), which can lessen the burden on water resources brought on by agricultural practices, are the only way to solve this issue (Pronti et al., 2024). One of the WCSTs is gun sprinkler irrigation, which is supported by its capacity to supply water to crops, adaptability to different soil types and terrains, potential for water conservation and achieving optimum production with little water use, and cost-effectiveness (Elkaoud et al., 2025).

Irrigating crops like wheat by gun sprinkler is very important as wheat is the most widely grown crop in the Ethiopia (CSA, 2012). Wheat is a vital crop in Ethiopia, ranking second in Africa's production (Braun, 2022), and in terms of areal coverage. Wheat production in Ethiopia is primarily rain-fed, with significant inter-annual and

seasonal variations in rainfall and frequent droughts (Esayas et al., 2018). In recent years, to achieve national food self-sufficiency, income generation, poverty alleviation, and socioeconomic growth, Ethiopia has chosen wheat as one of its target crops, with a special focus on expanding dry season and irrigated wheat cultivars. The adoption of irrigated wheat farming has gained momentum, particularly in areas with access to water resources (Tadesse et al., 2022). The government has invested in irrigation infrastructure, including the construction of dams and canals, to facilitate water supply for agricultural purposes (Mekonen, 2025). However, the widely used irrigation method is furrowing irrigation, which is laborious and less efficient. Furrow irrigation for wheat in Ethiopia leads to significant water loss, resulting in low water use efficiency (below 40%) due to poor water management, over-watering, and inadequate scheduling (Habtu, 2024). This poor practice causes negative impacts such as waterlogging, soil salinity and sodicity development, and can lead to land abandonment (Feyissa & Worku, 2023). Determining suitable irrigation technology is of paramount for promoting water-saving agriculture, particularly in well-irrigated regions (Zhang et al., 2024). The trend in Ethiopia is a growing but limited adoption of modern irrigation for wheat production, with gun sprinkler systems showing promise for increasing yields and water efficiency compared to surface irrigation methods.

1.1. Study Objective

- To evaluate portable gun type sprinkler irrigation on wheat crop.

2.0. Materials and Methods

2.1. Description of Study Area

The study was conducted at Dire Kiltu Kebele of Doddota district of Arsi Zone during the dry season of 2023/2024 and 2024/2025 on farmer's field and wheat was used as experimental crop. The area is located in the Central Rift Valley of Ethiopia. It is geographically located between the latitude of 8°17'30" to 8°22'30" N and longitude of 39°20'0" to 39°25'0" E and the mean altitude of the area is 1550m.a.s.l. The climate of the area is characterized as semi-arid with uni-modal low and erratic rainfall pattern with annual average of 824.9 mm. About 67.4% of the total rainfall of the area occurs from June to September. The mean maximum temperature varies from 26.3 to 31.0 °C while the mean minimum temperature varies from 10.4 to 16.4 °C.

2.2. Materials and Equipment Used

The materials used for field evaluation of portable gun type sprinklers were 4-inch water pump, suction pipe, delivery pipe (main line), 1.5-inch gun sprinkler head of 12mm nozzle size, reducer, elbow, riser and tripod stands, wheat seed, fertilizer (Urea and NPS), equipment such as core sampler, auger, stopwatch, pressure gauge, digital balance, double ring infiltrometer, meter tape, rope, hammer spatula and catch cun.

2.3. Installing of Gun Sprinkler System

The 4-inch water pump's suction pipe was placed within the reservoir. A suction pipe took water from the reservoir and transferred it to the delivery pipe. Water is moved to the main line via the delivery pipe. With the help of an elbow and reducer, the main line was attached to the tripod-supported riser. Next, the 1.5-inch rotating gun sprinklers with a 12-mm-diameter nozzle were positioned on top of the necessary riser.

2.4. Setting Up of Operating Pressure

Pressure gauges were used to measure the system's pressure. A pressure gauge was attached at the centrifugal pump's discharge section to track the water pumping pressure entering the system. To measure the water pressure going to the sprinklers, two additional gauges were installed, one at the beginning of each of the two laterals. This is to ensure that a representative pressure was obtained by observing the flow. To obtain the necessary operating pressure for the tests, the centrifugal pump's output pressure was adjusted. The test was carried out with the centrifugal pump operating at pressures of 250, 300, and 350 kPa. The throwing radius of the gun sprinkler head was measured and noted at each pressure and nozzle size. This procedure was adopted from the work done by (Salisu et al., 2024).

2.5. Experimental Design of the Study

The experimental design was layout by randomized complete block design with three replications. The treatments considered were two factors namely three-operating pressure and three riser height. The three 250kpa (P1), 300kpa (P2) and 350kpa (P3) pressure and three riser height 1.5m (H1), 2m (H2) and 2.5m (H3)) were used.

2.6. Data Collection

2.6.1. Climate Data Collection and Analysis

The 30 years daily climate data such as Rainfall, Tmax, Tmin, Relative Humidity, sunshine hours and wind speed was collected from Wenji metrological station. Filling the data gaps, trimming outliers and homogeneity tests were done for obtaining continuous and mean data over time.

2.6.2. Soil Sampling and Analysis

Soil textural analysis was done using disturbed soil samples that were collected from representative location of the field and textural class was determined by using pipette method in laboratory. The bulk density was determined using undisturbed soil samples using a cylinder core sampler with a size 5 cm in diameter and 5 cm in height that were collected from the field at three depths (0 -30 cm, 31-60 cm and 61 – 90 cm) and oven dried for 24 hrs at 105 °C and weighed for determination of dry mass. The bulk density was calculated as (Michael, 2008):

$$\rho_b = \frac{M_s}{V_t} \quad (1)$$

Where: ρ_b = is the bulk density of the soil in g/cm^3 , M_s = is dry mass of the soil (g), V_t = Total Volume of the soil (cm^3).

Field capacity and permanent wilting point were determined in the laboratory using a pressure-plate apparatus by applying 1/3 bars pressure to a saturated soil sample for field capacity and applying 15 bars pressure to determine the permanent wilting point. The soil moisture was determined by gravimetric method. Total available water (TAW) was computed from the moisture content of field capacity and permanent wilting point using the following Eqn.:

$$\text{TAW} = (\text{FC} - \text{PWP}) \times \rho_b \times Dz \quad (2)$$

Where: FC = Field capacity (% by weight), PWP = Permanent wilting Point (% by weight), D_z = depth of root zone (mm).

2.6.3. Crop and Irrigation Water Requirement Determination

Crop water requirements (ET_c): It was estimated by multiplying the Reference evapotranspiration (ET_o) value with the established K_c value:

$$ET_c = ET_o \times K_c \quad (3)$$

Where: ET_c is Crop evapotranspiration (mm/day), ET_o is Reference crop evapotranspiration (mm/day), K_c is Crop coefficient (fraction).

Reference evapotranspiration (ET_o): It was estimated by using by the Penman-Monteith equation which recommended by FAO(Allen *et al.*, 1998) using CROPWAT 8.0 software as:

$$E_o = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T + 273} U_2 (e_s - e_a)}{\Delta + \gamma (1 + 0.34 U_2)} \quad (4)$$

Where: Δ = Slope of the saturation vapor pressure curve at air temperature (kPa °C⁻¹), R_n = Net radiation at the crop surface (MJm⁻² d⁻¹), G = Soil heat flux density (MJm⁻² d⁻¹), γ = Psychrometric constant = 0.665 × 10⁻³ × P, kPa °C⁻¹ (Allen *et al.*, 1998), U_2 = Wind speed at 2 m height (m s⁻¹), e_s = Saturation vapor pressure (kPa), e_a = Actual vapor pressure (kPa), $(e_s - e_a)$ = Saturation vapor pressure deficit (kPa), T_{mean} = Mean daily air temperature at 2m height (°C).

Irrigation water requirements (IWR)

The IWR of wheat for growing period for different treatment was calculated as IWR was estimated as:

$$IWR = ET_c - P_{eff} \quad (5)$$

Where IWR = is Irrigation requirement (mm), P_{eff} = is effective rainfall (mm).

Effective rainfall (P_{eff}): P_{eff} was estimated using the method given by (Allen *et al.*, 1998):

$$P_{eff} = 0.6 * P - 10 \quad \text{for month } P \leq 70 \text{ mm} \quad (6)$$

$$P_{eff} = 0.8 * P - 24 \quad \text{for month } P > 70 \text{ mm} \quad (7)$$

Where, P is daily rainfall (mm).

Irrigation Time (T_{irr}): T_{irr} was estimated by dividing irrigation water requirement by application rate:

$$T_{irr} = \frac{IWR}{AR} \quad (8)$$

Where, T_{irr} = is irrigation time in hour, AR = is application rate (mmhr⁻¹).

2.6.4. Evaluation Parameter of Rain-Gun Sprinkler Performance

Measurement of Radius of Throw

Radius of throw of rain-gun was measured by tape under given pressures. A gun sprinkler head was selected while operating and allowed to distribute water over a given circular area. The catch cans were placed at measured

distances from the rain-gun in four quadrants. The water collected in each catch can was measured and recorded according to the methodology adapted by Muhammad *et al.* (2000). The distance from gun sprinkler, to the last catch can where water reached is the radius of coverage of the rain-gun under a specific pressure. The experiment was carried out during the dry season; therefore, detection of the farthest radius of throw by the sprinkler head was possible.

Determination of Discharge Rate

The volumetric discharge of the rain gun sprinkler head was measured with the aid of a flexible water hose and a bucket of known volume. The lengths of the flexible water hoses were connected to the two nozzles of the sprinkler while operating. The water was directed into the bucket. The time taken to fill the bucket was recorded and used to compute the sprinkler discharge using equation given by (Geleta, 2019) and (Salisu *et al.*, (2024) as:

$$Q = \frac{V}{t} \quad (9)$$

Where, Q = gun sprinkler discharge (ls^{-1}), V = volume of water collected (l), t = time(s).

Totally eighteen (18) tests were carried out across the lateral pipes to measure discharge of gun sprinkler by connecting flexible hose to each of gun sprinkler nozzles and allowing the water to fill a known volume of bucket. The discharge from the two nozzles were collected separately and finally added together.

Determination of Application Rate

Application rate of the rain gun gives information whether the nozzle size properly matched to the sprinkler head for the soil, crop and terrain on which they operate (Ahmed, 2023). The quantity of water collected in each catch can divided by area of mouth of the catch can gave depth of water applied to the field. The depth of water divided by time duration of the rain-gun gave application rate. The average application rate was obtained by dividing the sum of the depths of water collected in each catch can by total number of catch cans. In this method, the wetted areas were not considered so the theoretical application rate was obtained the following relationship (James, 1988; Muhammad *et al.*, 2000; Ahmed, 2023):

$$AR = K \frac{Q}{a} \quad (10)$$

Where: AR = application rate of the rain-gun (mm hr^{-1}), Q = rain-gun discharge l/m, a = wetted area of gun sprinkler, m^2 , k = constant, K= 60.00.

The wetted area of the gun sprinkler was calculated using the following relationship:

$$a = \pi r^2 \quad (11)$$

Where: a = wetted area of the rain-gun, m^2 and r = throw radius of gun sprinkler.

Uniformity coefficient (UC)

Application uniformity for gun type sprinkler was expressed by Christensen uniformity coefficient which calculated based on measuring the collected water in catch cans as developed by Christiansens (1942) and described by (ASAE, 1998) as fallow:

$$CU = 100(1 - \frac{\sum_{i=1}^n |x_i - \bar{x}|}{n\bar{x}}) \quad (12)$$

Where: - CU = refers to Christian uniformity coefficient, X_i = individual water depth collected by catch cans (mm), $\bar{x}$ = refers to the average of all measurements in catch cans (mm), n = refers to the total number of collectors.

Distribution Uniformity (DU)

Distribution uniformity (DU) is determined as a function of the relation between is average depth of water collected in the Lowest quarter(l/hr), and average depth of water collected in entire test area (l/hr), as shown in Equation (Zamaniyan et al., 2014) below:

$$Du = 100 * \frac{q_{25\%min}}{q_{mean}} \quad (13)$$

Where: D_u = is Emission uniformity (%), $q_{25\%min}$ = average depth of water collected in the lowest quarter (l/hr), q_{mean} = is average depth of water collected in entire test area (l/hr).

The evaluated system is classified according to the DU values, following Merriam and, Keller (1978). DU is always between 0 and 1. The larger the value of DU, the better the uniformity.

Coefficient of variation (CV)

The coefficient of variation (CV) is the quotient between the standard deviation of the applied water depths (σ) and the average of water depth collected according to (ASAE, 1998):

$$C_v = \frac{\sigma}{\mu} \quad (14)$$

Where σ = Standard deviation of the water depth of catch-cans, μ = Mean of all water depth of catch-cans, ml.

Water and irrigation water-use efficiency

Water use efficiency (WUE) and irrigation water-use efficiency (IWUE) values were calculated with following Eqn (Howell *et al.*, 1990):

$$WUE = \left(\frac{E_y}{E_t} \right) * 100 \quad (15)$$

Where: WUE = is the water use efficiency ($t\ ha^{-1}\ mm$); E_y = is the economical yield ($t\ ha^{-1}$); E_t = is the plant water consumption, mm.

$$IWUE = \left(\frac{E_y}{I_r} \right) * 100 \quad (16)$$

Where: IWUE = is the irrigation water use efficiency ($t\ ha^{-1}\ mm$), E_y = is the economical yield ($t\ ha^{-1}$), I_r = is the amount of applied irrigation water (mm).

2.7. Data Analysis

Data was analyzed for variability using the R software. Mean separation was done using the Least Significance Difference (LSD) method at 5% level of probability.

3.0. Results and Discussions

3.1. Soil Physical Properties Study Area

From the soil texture, laboratory analysis results showed that the average proportions of sand, clay and silt percentages were 64, 15, and 21, respectively. Thus, according to the USDA soil textural classification, the soil textural class was found in sandy loam soil. The average field capacity and wilting point of soil for common root depth (0-90 cm) in the study area was 21.2% and 11.3%, respectively. The total available water 146.0 mm/m at a soil depth of 90 cm. The average infiltration rate for the soil in the experimental field was 0.4 mm/min. To prevent surface runoff and field erosion, this value must be at least as high as the sprinkler head's application rate. For the same soil type (sandy-loam), the infiltration rate found in this study falls between 20 and 30 mm/hr, as indicated by the FAO (2002). This demonstrates the soil's good rate of infiltration and moderate drainage characteristics.

Table 1. Physical Properties of Experimental Soil.

Depth (cm)	FC (%)	PWP (%)	BD (g/cm ³)	TAW (mm/m)	Sand (%)	Clay (%)	Silt (%)	Textural class
0-30	20.7	10.9	1.45	142.1	64.4	15.0	20.6	sandy loam
31-60	21.4	11.5	1.48	146.5	64.00	15	21	sandy loam
61-90	21.6	11.5	1.48	149.5	62.0	15.5	22.5	sandy loam
Average	21.2	11.3	1.5	146.0	64.0	15.0	21.0	sandy loam

Where: FC (%) =field capacity in %, PWP (%) =Permanent Wilting Point in %, BD (g/cm³) = Soil bulk density in gram per centimeter cub, TAW (mm/m) = Total Available water in millimeter per meter.

3.2. Crop and Irrigation Water Requirement of Wheat

Wheat crop was irrigated at five days intervals using the amounts of applied water as 100% of crop water requirement. Irrigation treatment started after full emergence. the total amount of crop water requirement and irrigation water consumed was 4820 m³/ha and 4058m³/ha respectively. The result was in closed with Tezera *et al.* (2019) finding who reported that the seasonal crop water requirement of wheat determined by using Lysimeter was 4140m³/ha in the Central Rift Valley of Ethiopia.

3.3. Discharge of Gun Sprinkler at Different Riser Height and Operating Pressure

The average discharge measured from different testing combinations. The result of finding showed that as operating pressure increased the discharge of gun sprinkler also increased at common riser height and the largest discharge delivered by the 1.5m riser height at common operating pressure when compared to 2m and 2.5m riser height (figure1).

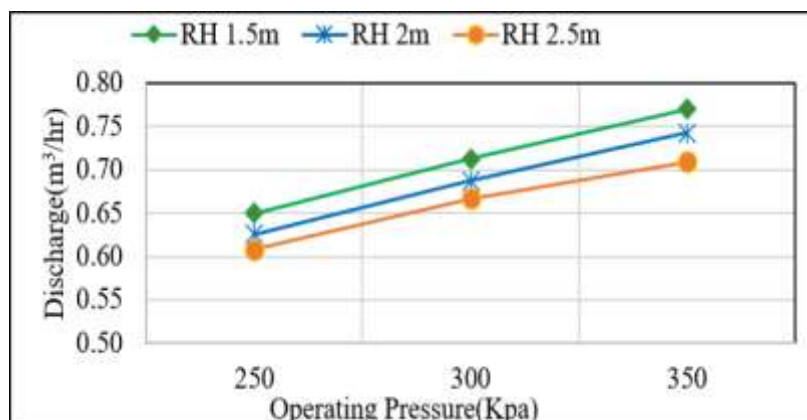


Figure 1. Pressure, Riser Height and Discharge relationships.

The findings showed that operating pressure had a significant impact on gun sprinkler discharge. Other researchers' studies (Muhammad *et al.*, 2000; Khedr, 2020; Vamsi *et al.*, 2021) provided support for this investigation.

3.4. Radius of throw of gun sprinkler at different riser height and operating pressure

The radius of throw increased with operating pressure under the same riser height but in case of riser height 2.5m; the radius of throw was lower than that of riser height 2m as shown in (figure 2). similar results were observed by other researchers (Muhammad *et al.*, 2000; Khedr, 2020; Fayed *et al.*, 2022). According to study done by Vamsi *et al.* (2021) ,showed that the radius of throw increased as the riser height increased up optimum height and radius of throw slightly began to decrease in comparison to optimum riser height.

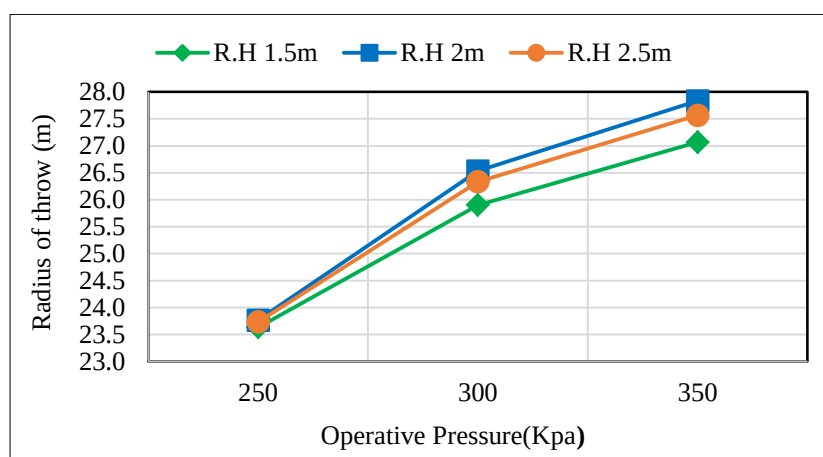


Figure 2. Operative Pressure, Riser height vs radius of throw relationships.

3.5. Application Rate of Gun Sprinkler at Different Operating Pressure and Riser Height

Under the same riser height, the application rate increased as operating pressure increased. In contrast, as riser height increased, the application rate decreased. The combination of operation pressure 350 kPa and riser height 1.5 m produced the highest average application rate of 22.3 mm/hr, while the combination of operation pressure 250 kPa and riser height 2.5 m gave the smallest average application rate of 17.8 mm/hr as showed in figure 3. As a result, the application rate was lower than the study area's sandy loam soil infiltration rate (2.4 mm/hr) when operating pressure and riser height were combined.

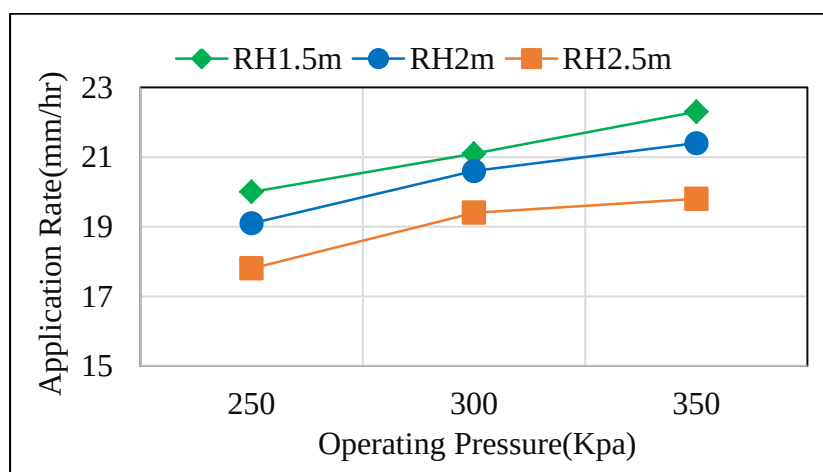


Figure 3. Operating Pressure, Riser Height and Application Rate Relationships.

This suggested that it was crucial that using gun sprinkler of 12mm nozzle size in study area was important. This finding was in lined with Bishaw & Olumana, (2016) who stated that the interaction effect of rising height and operating pressure on water application rate for a gun sprinkler shows that increasing operating pressure generally increases water application rate, while increasing riser height tends to decrease it, this may be due to increased water losses from wind drift and evaporation.

3.6. Gun Sprinkler Irrigation Performance Under Different Pressure and Riser Height

The distribution uniformity, uniformity coefficient, and coefficient of variation of gun sprinkler irrigation are all affected by operational pressure and riser height. At the combined effect of operating pressure and riser height (300 kpa and 2.5 m), (350 kpa and 2 m), and (350 kpa and 2 m), the maximum a coefficient of variation, uniformity coefficient, and distribution uniformity of 9.3%, 97.7%, and 97.2%, where recorded respectively as indicated in table 2. In contrast, at combined effects of (350kpa and 2m), (250kpa and 1.5m), and (250kpa and 1.5m) operational pressure and riser height the lowest coefficient variation (%), uniformity coefficient (%), and distribution uniformity (DU) of 3.1%, 94.9%, and 86.0%, were recorded respectively. Under the combined effect of operative pressure 350 kpa and riser height 2 m, the lowest coefficient of variation, the highest uniformity coefficient, and distribution uniformity were found. This suggests that lower CV is better and suggests more uniform water application and higher uniformity coefficient. The distribution uniformity of gun sprinklers increased as operation pressure increased to an optimum riser height, but after that, factors like wind effects or evaporation caused the distribution uniformity to decrease, resulting in less uniform water distribution at high riser heights. This finding was supported by Ashine & Bedane, (2022).

Table 2. Gun Sprinkler Irrigation Performance Under Different Pressure and Riser Height.

OP (Kpa)	RH (m)	CV (%)	UC (%)	DU (%)
250	1.5	8.4±1.9 ^{ab}	94.9±2.1 ^b	86.0±1.6 ^e
	2	7.3±1.5 ^{ab}	95.5±0.7 ^{ab}	89.3±0.3 ^d
	2.5	6.8±1.1 ^{abc}	95.6±0.8 ^{ab}	88.4±0.4 ^{de}
300	1.5	5.5±2.3 ^{bc}	97.1±0.6 ^{ab}	92.7±1.4 ^{bc}
	2	5.9±2.4 ^{abc}	96.1±2.4 ^{ab}	93.5±1.5 ^{bc}
	2.5	9.3±3.6 ^a	95.0±3.5 ^b	85.6±5.3 ^e
350	1.5	5.7±3.3 ^{abc}	96.2±1.1 ^{ab}	94.6±0.7 ^{ab}
	2	3.1±0.5 ^c	97.7±0.3 ^a	97.2±1.8 ^a
	2.5	6.4±1.3 ^{abc}	96.3±1.2 ^{ab}	91.5±1.0 ^{cd}
Mean		6.5	96.1	90.9
SEM±		4.8	2.4	3.2
LSD		3.7	2.7	3.1

Where, OP=Operating Pressure (Kpa), RH = Riser Height (m), CV=Coefficient of Variation (%), UC= Uniformity Coefficient (%), DU=Distribution Uniformity (%), SME±=standard Error of Mean Values are Mean ± SD. Means in columns followed by the same letters are not significantly different at a 5% level of significance.

3.7. Water Use Efficiency and Wheat yield component under different operating pressures and riser heights

The highest crop height, straw yield, grain yield, and WUE was 93.6cm, 5.590t/ha 3.823t/ha, and 0.77kg/m³ (Table 3). This showed that increased water productivity is closely related with greater water uniformity. There is less

variation in crop development and grain filling when each crop in the field receives a uniform and sufficient amount of water, which increases the overall yield output. This finding was supported by El-wahed *et al.* (2015), who revealed that both coefficient of uniformity and distribution uniformity of sprinkler irrigation system were increased with increasing both the operating pressure and optimum riser height of sprinkler from ground level. Similarly Bishaw & Olumana (2016) finding revealed that both the riser height and operating pressure significantly impact a gun sprinkler's water use efficiency through their effects on water distribution patterns.

Table 3. Water Use Efficiency and Wheat Yield Component Under Different Operating Pressure and Riser Height.

OP (Kpa)	RH (m)	CH (cm)	SY (t/ha)	GY (t/ha)	WUE (kg/m ³)
250	1.5	87.07 ± 0.40 ^e	4.023 ± 0.35 ^d	3.457 ± 0.01 ^{cd}	0.56 ± 0.05 ^d
	2	86.73 ± 0.31 ^e	4.623 ± 0.02 ^{bc}	3.407 ± 0.01 ^{de}	0.64 ± 0.00 ^{bc}
	2.5	85.67 ± 0.58 ^f	4.400 ± 0.03 ^{cd}	3.377 ± 0.01 ^e	0.61 ± 0.00 ^{cd}
300	1.5	89.67 ± 0.76 ^d	4.873 ± 0.14 ^{bc}	3.440 ± 0.04 ^{de}	0.67 ± 0.02 ^{bc}
	2	91.77 ± 0.25 ^c	4.853 ± 0.11 ^{bc}	3.537 ± 0.02 ^b	0.67 ± 0.02 ^{bc}
	2.5	92.00 ± 0.50 ^c	4.083 ± 0.75 ^d	3.517 ± 0.05 ^{bc}	0.56 ± 0.10 ^d
350	1.5	92.83 ± 0.29 ^b	5.10 ± 0.16 ^{ab}	3.577 ± 0.08 ^b	0.71 ± 0.02 ^{ab}
	2	93.60 ± 0.36 ^a	5.59 ± 0.14 ^a	3.823 ± 0.06 ^a	0.77 ± 0.02 ^a
	2.5	91.27 ± 0.31 ^c	4.66 ± 0.02 ^{bc}	3.523 ± 0.01 ^{bc}	0.65 ± 0.01 ^{bc}
Mean		90.07	4.69	3.517	0.65
SEM±		0.19	0.09	0.00	0.00
CV (%)		0.5	6.4	1.1	6.2
LSD		0.76	0.51	0.07	0.07

Where: OP=Operating Pressure (Kpa), RH = Riser Height (m), CH=Crop Height (cm), SY=Straw yield (t/ha), GY=Grain yield (t/ha), and WUE=Water use efficiency (kg/m³), CV=Coefficient of Variation (%), SME±= standard Error of Mean Values are Mean ± SD. Means in columns followed by the same letters are not significantly different at a 5% level of significance.

4.0. Conclusion and Recommendation

The performance of gun sprinkler under different operating pressure and riser height on farm was evaluated to supply water for production of wheat. The result of study revealed that the discharge, radius of throw and application rate increase with operating pressure under the same riser height. The highest distribution uniformity, crop height, straw yield, grain yield, irrigation water use efficiency and water use efficiency was obtained under combined effect of operating pressure 350kpa and 2m riser height. Therefore, for similar agro climatic condition like Doddota using gun sprinkler with nozzle size of 12mm under operating condition of 350kpa and riser height 2m was recommended for obtaining higher distribution uniformity and wheat yield.

Declarations

Source of Funding

This study was financially supported by the Oromia Agricultural Research Institute.

Conflict of Interest

The authors declare that any known competing financial interests or personal relationships did not influence the work described in this publication.

Consent for Publication

The authors declare that they consented to the publication of this study.

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