

Research Article

Technical Applications of Levelling Machines in Some Maize Varieties Productivity

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Abstract | Soil levelling plays a vital role in regulating plant growth and ensuring uniform moisture distribution, which in turn helps conserve water by delivering water at a consistent level to all parts of the field, particularly in the root zone. Also, selecting the optimal varieties for the growing conditions is extremely important. So this study aimed to evaluate the effects of different maize varieties and levelling machines on maize growth and yield under an automated sensor-based subsurface drip irrigation system. A field experiment (2025) was conducted in a farmer's field in Al-Hashimia. The experimental design was a split-plot RCBD with three replicates. The main plots consisted of four maize varieties (Furat FU, ZP, Marvel MA, and Saginto SA), and sub-plots consisted of three levelling machines (Laser, Tablet, and Grader) for the An AI-driven system controlled water and fertilizer delivery, the results demonstrated that the SA variety also surpassed FU, ZP and MA in all growth and yield parameters: Plant height (PH; 193.16 cm), leaf area (LA; 614.8 cm²), chlorophyll index in leaves (CIL; 50.19%), grains number in the ear (GNE; 495.1 grain ear⁻¹), 500 grains weight (500GW; 139.66 g), grains Yield (GY; 7.298 tha⁻¹) and biological yield (BY; 19.200 tha⁻¹). The Laser levelling machine significantly outperformed Tablet, and Grader across all measured traits. Optimal results were achieved with the interaction of Laser levelling machine and SA variety, highlighting this combination as the most effective for enhancing maize productivity under the studied conditions.

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Keywords | Maize (*Zea mays* L.), Varieties, Technological technique, Levelling machines, Irrigation.



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Introduction

Yellow maize (*Zea mays* L.) crop is considered an important strategic crop and ranks third after wheat and rice, it serves as a basic ingredient for human food worldwide, in addition to its great importance in feeding animals as dry and green

fodder (Aljibouri and Alsharifi., 2019; Mohammed *et al.*, 2022). The yellow corn crop is distinguished by its abundant production, its cultivation in two spring and fall seasons, and its adaptation to environmental conditions in Iraq. The Agriculture Ministry has taken it upon itself to encourage farmers to grow the corn crop according to scientific principles by adopting

modern irrigation methods, because the leaves of this crop are used in the paper manufacture, while grains its, extracted from it the finest types of starch, dextrin, and oils (Aljibouri *et al.*, 2022), This calls for thinking about using modern scientific methods to improve the yield of yellow maize by following settlement methods and fertilizers, method is one of the basic outcomes in increasing the characteristics of vegetative growth and yield (Alaamer *et al.*, 2023a). The leveling process is one of the most important methods used to improve the soil characteristics and mix it, to achieve the best nutrients absorption through a homogeneous distribution of water (Shathar and Alsharifi., 2023). Among the most important measures that farmers should consider is modifying their crop varieties to increase their productivity per unit area by carrying out all the agricultural operations required by the plant during the growing season (Prasanna *et al.*, 2021; Zabel *et al.*, 2021). Economic crops, such as corn, need a balance of the major nutrients necessary for the growth and development of the plant, especially the most important, which the plant needs in relatively large quantities, and their deficiency creates a significant impact on growth and productivity, the focus is on such elements due to their depletion by the plant, their fixation in the soil, or their leaching in the root area. Therefore, they must be added to the soil to create nutritional balances aimed at improving the plant vegetative growth and increasing the final yield, for the selected variety (Nanganoa *et al.*, 2020; Januszkiewicz *et al.*, 2025). Study conducted by Miao *et al.* (2021) showed that applying added nutrients to maize crops led to improved grain quality. On the other hand, Kodua *et al.* (2022) benefited that increases crop yield when combined with other agricultural practices such as tillage and leveling. Amer *et al.*, 2021; Racz *et al.* (2021), it been proven that fertilization reduces the environmental stress that plants experience during their growth period, and it has been confirmed that the fertilizers application is concentrated when the soil is under water stress. Foliar spraying plays a vital role in promoting the growth and corn varieties productivity when used in conjunction with appropriate leveling methods, leads to an increase in vegetative growth indicators. Plant height and chlorophyll ratio. Jing *et al.* (2022); Mueen *et al.* (2025), numerous studies have confirmed the synergy between selected variety and modern leveling processes, opening up prospects for sustainably improving plant productivity by exploiting the characteristics for each variety. Alaamer and

Alsharifi, (2020); Singh *et al.* (2021). Increasing grain productivity and improving its quality is achieved by selecting varieties that give the highest yield to ensure food security in line with the increasing population. Anang *et al.* (2022); Guevara *et al.* (2022), soil leveling is an important agricultural practice for uniform water distribution across the soil surface and achieving field capacity. Khngura *et al.* (2023). Increasing crop yield, ensuring water availability, and achieving uniform water distribution across the soil requires achieving a 0-2% slope using a laser leveling machine. Chen *et al.* (2024). Laser leveling has improved water use efficiency and enhanced growth characteristics and grain yield.

The economic return of any agricultural crop is affected by the genetic aspect for the selected variety, in addition to the environmental aspect represented by temperature, humidity, and the exposure length to light, which play an effective and fundamental role in increasing growth characteristics and productivity (Shtewy *et al.*, 2020), Despite increasing awareness of advanced technologies, technological gaps remain, current studies often focus on these gaps without fully evaluating the application of technology across the corn production cycle. New technologies have a significant impact on growth stages, leading to increased final yields and ensuring food security, corn production a key factor (Majebele *et al.*, 2025). Laser leveling achieved the highest overall rice yield compared to unlevelled land, due to the water abundance and its uniform distribution within the root zone (Ramya *et al.*, 2022). Varieties can contribute to tolerance of all stress factors such as drought and heat, as well as facilitating their management and shortening their growth cycles (Martey *et al.*, 2020; Nawaz *et al.*, 2023), several factors affect crop yields, including failure to follow scientific principles, high seed prices, and the undesirable characteristics for selected varieties to cultivation (Lamichhane *et al.*, 2022). Soil leveling improved the fertilizers efficiency and water, ultimately leading to increased crop yield and higher economic returns. This is attributed to the water abundance in the root zone (Kumari *et al.*, 2025). The soil physical properties, such as density and porosity, were affected as a result of the increased load on the soil surface, leading to compaction, deterioration of its condition, and decreased fertility. This is attributed to the heavy equipment use, that passes over the soil surface and compacts the topsoil. This increases soil density, decreases porosity, deteriorates plant growth,

and reduces the final yield (Mankhi and Jebur, 2022; Munialo *et al.*, 2020), Increase in chlorophyll index in the leaves may be due to the increased concentration of nitrogen and potassium in the leaves, which led to an increase in the accumulation of nitrogen and potassium in the plant and then an increase in the permeability of nutrients in the plant and an improvement in the carbon representation process, which results in an increase in the content of chlorophyll in the leaves. (Moi and Dutta 2020), Crop productivity increases through the adoption of improved varieties IMV, as these varieties prove effective in improving agricultural performance and efficiency, ultimately contributing to improved livelihoods for farmers, increased profits, and enhanced food security.(Mdoda *et al.*, 2025), most farmers suffer from limited resources, so the focus is on special measures for soil and crop management by selecting the variety that gives the highest productivity under the growing conditions. Soil leveling, which works distributes water with minimal loss and high efficiency, is one of the most important factors for modernizing agriculture, the main purpose of soil leveling is to maximize the use of water resources in a scientifically sound manner and to increase the cultivated area from uncultivated land. Therefore, the current study aimed to determine soil leveling and its effect on the growth characteristics and productivity some maize varieties.

Material and Methods

Study site

Al-Hashimiyah City, the district center of Babylon Governorate, is situated in the Middle Euphrates region, approximately 130 km south of Baghdad. Known for its fertile agricultural lands, the area is renowned for its orchards and cultivation of strategic crops such as wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.), and corn (*Zea mays* L.) (Figure 1).

A field experiment was conducted during the 2025 summer growing season in a farmer's field under the Al-Hashimiyah Agriculture Directorate, Babylon Governorate, to evaluate yellow corn (*Zea mays* L.) production under specified experimental conditions.

Field soil preparation

Prior to planting, soil samples were collected from nine randomly selected locations (0-20 cm depth) with three replicates each for comprehensive

physicochemical analysis. The sampling area was determined based on experimental requirements, with results presented in Table 1.

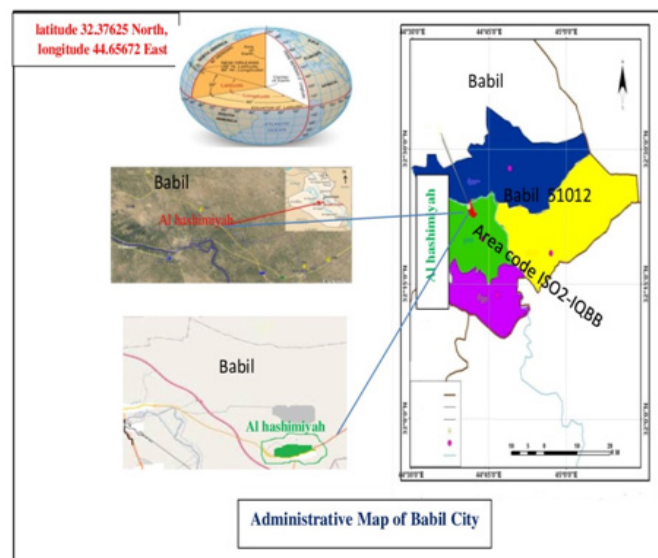


Figure 1: Study site

Table 1: Analysis of soil physical and chemical characteristics

Depth	Texture %			
0-20 (cm)	Clay	Silt	Sand	
	66	19	15	Clay
	Soil physical properties			
	Pb (Mg m ⁻³)	TSP (%)	SPR (Kpa)	
	1.22		1455.09	field capacity %
	1.26		1567.82	33.12
	1.30		1605.44	32.43
VA				
0-20	Soil chemical properties			
	E.C (ds\ cm ³)	HP	True density (Mg.m-3)	
	2.34	7.42	2.55	
	Soluble cation meq\l			
	Na	K	Ca+Mg	
	8.21	12.16	55.15	
	O.C (%)	CEC Meq\100 g)	CaCo3 (%)	O.M (%)
0.55	31.88	4	0.65	

The soil was prepared by plowing using a moldboard plow and the tiller was set to a depth of 20 cm to stir the soil, the soil was smoothed using double disc combs. The soil was leveled using leveling equipment arranged according to a randomized complete block design arranged in split plot with three replications.

The field is then divided into several experimental plots with 36 experimental units measuring 3x3.5 m², with a distance of 75 cm between the experimental units and 1 m between the sectors, 20 cm between one hole. A locally developed fertilizer application machine is used to apply a triple phosphate fertilizer at a rate of 120 kg ha⁻¹ at a time and to a depth of 8 cm before planting (Nayyef *et al.*, 2024 ; Amer *et al.*, 2025). The planter type sowing machine, was set at 100 kg ha⁻¹ for the FU variety with a leveling machines LIM , GLM and TLM, then the same process was repeated for the SA, ZP and MA varieties.

Experimental field topography

Topography directly influences soil formation through slope, as there is a direct relationship between surface slope and water flow velocity. This affects the water infiltration amount, soil dryness, vegetation density, and organic matter content. Soils in sloping areas are also characterized by their shallowness and limited depth. Soil topography has a significant impact on the crops nutrient content. Also soil slope and inclination affect the nutrient content; therefore, leveling the soil increases crop growth rate.(Shathar *et al.*, 2024). The selected experimental soil consisted of scattered clumps at heights that affected both seed distribution and water level (Figure 2).

The readings obtained using a level device (Figure 3, (difference between front (F.S) and back (B.S) readings.

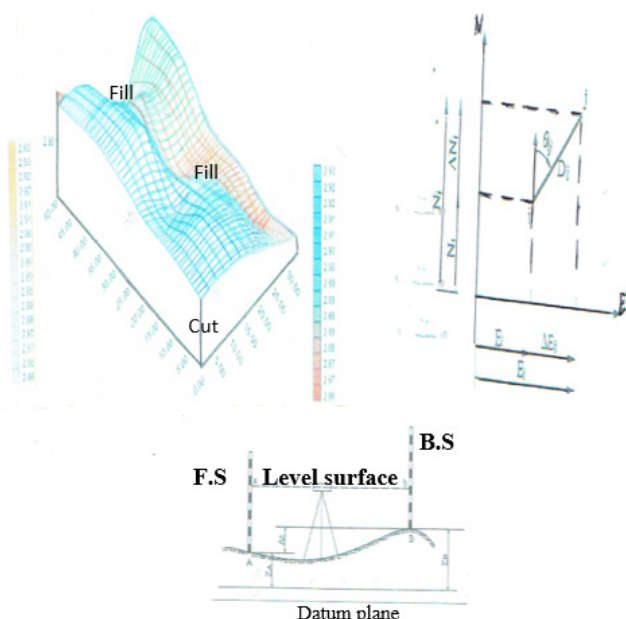


Figure 2: Soil topography, and readings taking method
Topographic surveying

Points identified and readings taken, using the theodolite (Transit), Figure 3

$$L_{TU} = L \times \cos \text{ Bearing}$$

$$D_{PU} = L \times \sin \text{ Bearing}$$

The leveling device was attached on the MF- 285S tractor. The field was surveyed to determine elevations, depressions, and field characteristics using a MAST (This device consists of a graduated rod for measuring elevation and depressions via a hydraulic piston that controls the raising and lowering of the receiver as needed by connecting the hydraulic device to a P.T.O unit for tractor). Therefore, a virtual field diagram or network is created (Figure 3), showing the rises and falls by setting the zero level in the transmitter and determining the tractor path.

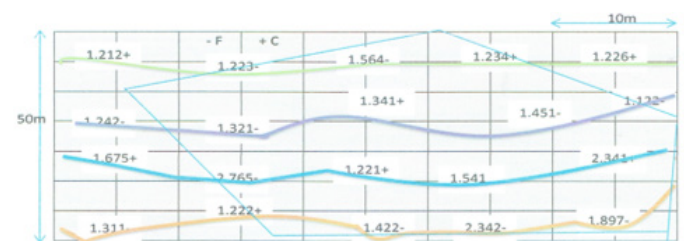


Figure 3: Network diagram for MAST before making leveling process.

The experiment includes two factors

i) The first factor comprising of four different maize varieties. Those are Furat, ZP, Marvel and saginto Furat (FU)

The Furat maize variety, Dutch hybrid approved by the Iraqi Agriculture Ministry, exceedingly cultivated in focal and southern Iraq, is describe by its discriminatory long and plump cob morphology. This variety has show freaked agronomic execution under Iraqi growing provision, specifically in semi-arid climates, combining high yield possibility with notable drought tolerance .Purity ratio 99% and germination ratio 93%.

ZP

This variety is characterized by its medium-length cob and average productivity. It also tolerates drought and salinity. Serbian hybrid, the growing conditions for this variety are limited to protected areas, but thanks to breeding and improvement, it has become possible to cultivate it in temperate regions. Purity ratio 99% and germination ratio 92%.

Marvel (MA)

This variety is characterized by its medium-length cob and average productivity, it has become possible to cultivate it in temperate regions. Purity ratio 99% and germination ratio 91%.

Saginto (SA)

The Saginto maize variety, a German hybrid approved by the Iraqi Ministry of Agriculture. It is characterized by its long, thick cop and high yield. Its cultivation is concentrated in central and southern Iraq, and it has proven tolerant of all the region's climatic conditions. Purity ratio 99% and germination ratio 94%.

Levelling machines

Levelling is a necessary and complementary process to preparing the soil for planting. It contributes to the water regular distribution , saves watering time, ensures uniform distribution for fertilizers, and guarantees that water reaches field parts all with equally

Table 2: Specifications(Laser leveling machine)

Parameter	
Display	Seven Segment LED, Visible in Day Light, Adjustable in Brightness
Switch	Tour Sensor Switch Suitable for Dusty Condition
System Accuracy	±5 mm
Control	Programmable
Working Mode:	10 User Modes Programmable
Indications:	Working Channel, Time & Errors (LED for Up, Down, Link & Auto)
Protection: IP65	
Connectors:	Silver coated, Chroe plated atll weather bend proof
Laser Guided Land Leveller Pro-12000	
Capacity 6m	
Weight 4300kg	
Dimensions 2500 x 3200 x 6600	

Laser levelling machine

Laser leveling is performed using a transmitter that emits a laser beam to the area surrounding the leveling machine up to a distance of 300 meters. A control box, positioned in front of the driver, operates automatically in conjunction with the other components of the leveling machine. A receiver is mounted on the cutting blade holder. A hydraulic unit, connected to the machine's hydraulic and the control box, for controls the raising and lowering of

the cutting blade via laser beam (Figure 4).



Figure 4: Laser leveling machine

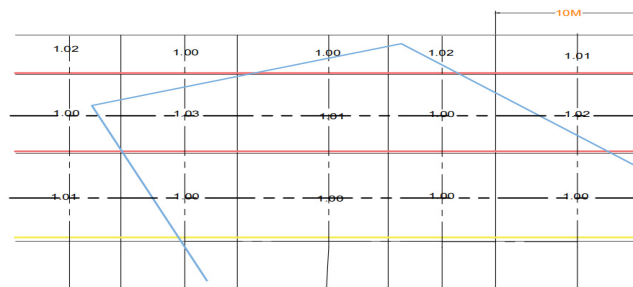


Figure 5: Readings obtained using levelling machine (Laser type)

Tablet levelling machine

This device is attached to the tractor's hydraulic lifting device and its depth is calibrated according to the elevation and depression readings in the test field, predetermined by MAST (Figure 6).

Table 3: Specifications(Tablet leveling machine)

Parameter	
local manufacturing machine	Iraq
hanging type	Back tractor
Width	2.76m
Weight	256 kg



Figure 6: Tablet leveling machine

Grader levelling machine

A levelling machine equipped with a cutting knife

				10M
0.75	0.68	0.52	0.55	0.46
0.63	0.56	0.74	0.60	0.54
0.60	0.73	0.81	0.67	0.58
0.65	0.52	0.67	0.75	0.62

Figure 7: Readings obtained using levelling machine (Tablet type)

in the middle, hydraulically controlled according to the readings specified by the MAST method for the height and depth.(Figure 8)

Table 4: Specifications(Grader leveling machine)

Parameter		Parameter	
Total length	8310 mm	Model	3306
Height to top of cab	3360mm	Maximum power	150ph
Width over tyres	2440mm	Number of cylinders	6
Blade base	2570mm	Displacement	10.5L
Wheelbase	5920mm	Operating voltage	24 v
Tandem axle wheelbase	1520mm	Type	Direct drive, power shift
Standard operational weight	12620 Kg	Ground clearance	610 mm
Tyre size	14×24 10PR	Wheel lean	18 degrees
Maximum forward speed	41 kmhr ⁻¹	Total oscillation	32 degrees
Maximum reverse speed	41 kmhr ⁻¹	Moldboard height	610mm
Moldboard thickness	22mm	Moldboard width	3660mm
Maximum depth of cut	438mm	Rotation	360 degrees
Side shift left and right	660mm	Diameter	1530mm
Shift right	520mm	Shift left	650mm
Maximum reach outside tyres – right	1830mm	Maximum lift above ground	464mm



Figure 8: Grader leveling machine

				10M
0.98	0.95	0.90	0.92	
0.89	0.85	0.91	0.93	
0.9	0.94	0.97	0.99	
1.00	1.03	0.95	0.93	

Figure 9: Readings obtained using levelling machine (Grader type)

Studied characteristics

Vegetative growth characteristics

Plant height (PH)

It was measured after the plant reached the flowering stage (100%), using an Invar strip measurements were taken from the soil surface to the flag leaf base for ten randomly selected plants from the midlines for each experimental unit, with three replicates (Alaamer *et al.*, 2023a).

Leaf area (LA)

It was calculated according to the Eq.3, approved by (Vanisree *et al.*, 2013; Shathar *et al.*, 2024).

$$L_A = FL \times FW \times 0.74$$

Where:

LA; Leaf area cm², *FL*; Leaf length cm, *FW* Leaf width cm.

Chlorophyll index in leaves (CIL)

It was calculated using a manual digital scaling device SPAD-502-meter and awarding to the method by (Mohammed *et al.*, 2022; Alaamer *et al.*, 2024).

Yield characteristics

Grains number in the ear (GNE)

After the plant reached physiological maturity, ten ears were taken from the midlines for each experimental unit (three replicates) and placed in husking and counting machine (Satak type), (Alsharifi *et al.*, 2025).

500 grains weight (500GW)

The 500-grain weight was specified by first classifying grains awarding to size and ejecting broken kernels using a Satake testing device (Alsharifi *et al.*, 2021). robust grains were then scaled using a precision electronic balance (accuracy ± 0.01 g)

Grains Yield (GY)

was calculated using the Eq.4, (Shtewy *et al.*, 2020; Alaamer *et al.*, 2026):

$$GY = GP \times PD$$

where:

GY = Grain yield (t·ha⁻¹), GP = Grain weight per plant (kg·plant⁻¹), PD = Plant density (plants·ha⁻¹)

Biological yield (BY)

It was calculated using the Eq.5, after drying the sample in the oven at 70 °C until the weight stabilized.

$$BY = PDW + PD$$

Where; BY; biological yield t·ha⁻¹, PDW; plant dry weight (kg) , PD; plant density (ha⁻¹)

Statistical analysis

The experimental data were analyzed using GenStat 18th edition (VSN International) with a split-plot arrangement in a randomized complete block design (RCBD). Treatment means were compared using Least Significant Difference (LSD) test at $\alpha = 0.05$ significance level.

Results and Discussion

Vegetative growth characteristics

Table 5 demonstrate significant effects ($p < 0.05$) of maize varieties , levelling machines, and their interaction on maize vegetative growth. High effects were observed with laser levelling machine + maize variety saginto, achieving peak values (197.14 cm, 625.4 cm², 53.10%). This supports with recognized levelling machines and maize varieties dynamics: balanced levelling and soil moisture availability promotes root expansion and homogeneous nutrient uptake, thereby supporting vegetative development

Table 5: Effect of levelling machines on the vegetative growth parameters for four maize varieties

Varieties	Levelling machines	Vegetative growth characteristics		
		PH	LA	CIL
FU	LLM	180.67	511.6	42.85
	TLM	171.81	346.9	37.96
	GLM	177.36	422.1	40.49
ZP	LLM	186.64	604.2	47.17
	TLM	181.42	566.5	40.85
	GLM	183.28	588.4	43.25
MA	LLM	191.25	621.9	50.68
	TLM	182.95	567.5	45.58
	GLM	185.11	606.2	46.10
SA	LLM	197.14	625.4	53.10
	TLM	189.46	601.1	46.79
	GLM	192.87	617.9	50.68
V	FU	176.62	426.8	40.43
	ZP	183.78	586.4	43.76
	MA	186.44	598.5	47.45
	SA	193.16	614.8	50.19
LM	LLM	188.93	590.8	48.45
	TLM	181.41	520.5	42.79
	GLM	184.65	558.6	45.13
LSD= 0.05	V	0.971	14.30	1.041
	LM	0.504	19.66	0.813
	V*LM	1.494	25.97	N.S

Maize variety Furat ;FU, maize variety ZP ;ZP, maize variety Marvel ;MA, maize variety Saginto ;SA, laser levelling machine; LLM, Tablet levelling machine; TLM, Grader levelling machine; GLM, plant height ;PH, leaf area ;LA, chlorophyll index in leaves ;CIL.

Figure 10. The SA variety produced superior growth metrics (plant height: 193.16 cm; leaf area: 614.8 cm²; chlorophyll index in leaves 50.19 %) surpassing FU



Figure 10: Effect of maize varieties on the maize vegetative growth

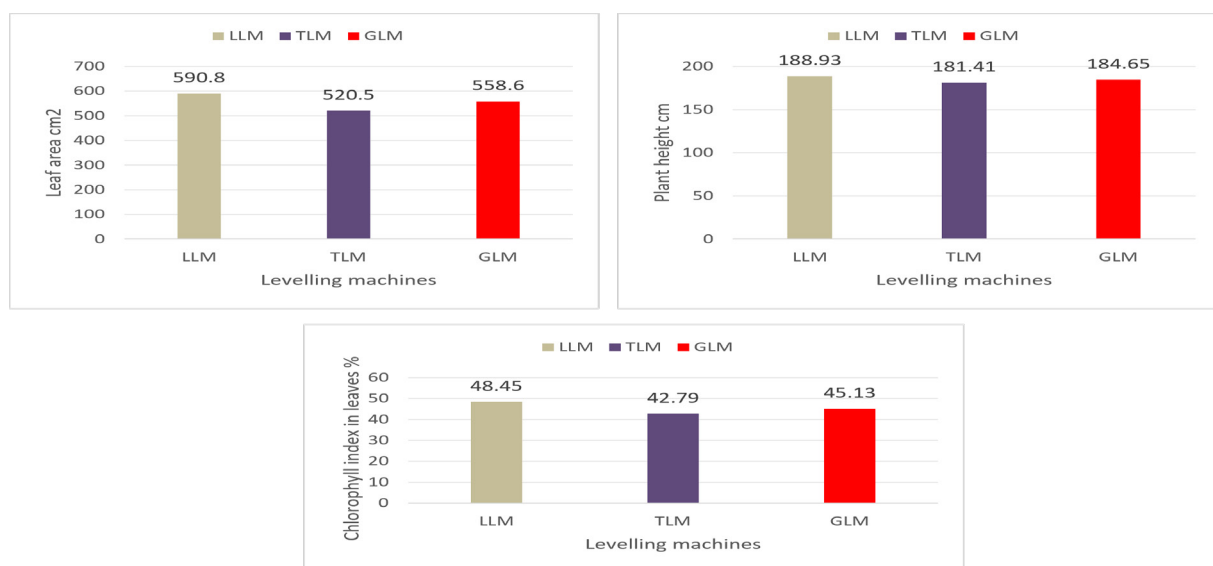


Figure 11: Effect of levelling machines on the maize vegetative growth

(176.62 cm, 426.8 cm², and 40.43%), ZP (183.78 cm, 586.4 cm² and 43.76%), and MA (186.44 cm, 598.5 cm², and 47.45%). This enhancement is attributed to This relates to genetic makeup and certain genes responsible for growth (Mohammed *et al.*, 2022). This is what was indicated by (Prasanna *et al.*, 2021; Zabel *et al.*, 2021), who found that the variation in growth duration depends on the plant's ability to manage enzyme activity and provide the energy necessary for photosynthesis, leaf growth, increased leaf area, and reduced senescence.

Figure 11. The LLM treatment increased vegetative growth (188.93 cm, 590.8 cm², 48.45%), TLM (181.41 cm, 520.5 cm², 42.79%) and GLM (184.65 cm, 558.6 cm², 45.13%). This is due to the levelling machine effect on the soil by levelling its surface, improving aeration, and reducing moisture loss, which leads to

increased root spread and more uniform distribution of water and fertilizers. This, in turn, results in increased vegetative growth (Chen *et al.*, 2024). This is (Shathar and Alsharif., 2023) confirmed, that the leveling process plays a vital role in regulating plant growth and maintaining soil moisture, which in turn improves the plant's vegetative condition during the growing season.

Yield parameters

Table 6, demonstrate significant effects ($p < 0.05$) of maize varieties , levelling machines, and their interaction on maize yield parameters. The optimal treatment combined levelling machine LLM type with SA variety, achieving record values (568.9 grain ear⁻¹, 139.66149.77 g, 8.268 t·ha⁻¹, 20.093 tha⁻¹), demonstrating synergistic effects between levelling management and nutrient availability.

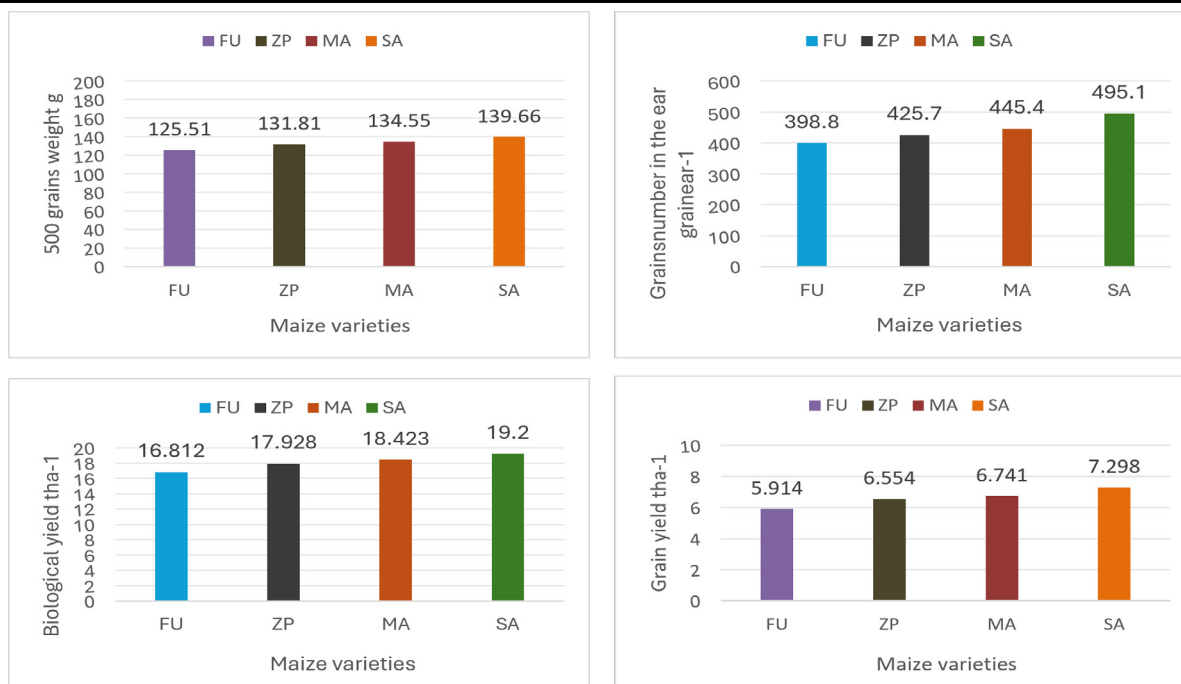


Figure 12: Effect of maize varieties on the maize yield parameters

Table 6: Effect of levelling machines on the yield parameters for four maize varieties.

Varieties	Levelling machines	Yield characteristics			
		GNE	500 GW	GY	BY
FU	LLM	449.1	133.26	6.166	17.263
	TLM	349.1	120.60	5.458	16.300
	GLM	397.8	122.69	6.119	16.873
ZP	LLM	491.8	138.42	7.733	18.500
	TLM	374.6	127.79	6.007	17.383
	GLM	410.7	129.21	6.484	17.900
MA	LLM	500.5	140.50	6.962	19.303
	TLM	401.7	130.77	6.219	17.983
	GLM	434.0	132.37	6.480	17.984
SA	LLM	568.9	149.77	8.268	20.093
	TLM	426.3	133.09	6.545	18.263
	GLM	490.1	136.12	7.082	19.243
V	FU	398.8	125.51	5.914	16.812
	ZP	425.7	131.81	6.741	17.928
	MA	445.4	134.55	6.554	18.423
	SA	495.1	139.66	7.298	19.200
LM	LLM	502.7	140.49	7.282	18.790
	TLM	387.9	128.06	6.057	17.482
	GLM	433.2	130.10	6.541	18.00
LSD= 0.05	V	10.23	1.137	0.141	0.135
	LM	9.69	1.010	0.164	0.181
	V*LM	16.78	1.845	0.243	0.243

Grains number in the ear; GNE, 500 grains weight; 500GW, grains yield; GY, biological yield; BY.

Figure 12. The LLM treatment increased yield parameters (grains number in the ear; 502.7 grain ear⁻¹, 500 grains weight; 140.49 g, grains yield; 7.282 tha⁻¹, biological yield; 18.790 tha⁻¹), TLM (387.9 grain ear⁻¹, 128.06 g, 6.057 tha⁻¹, 17.482 tha⁻¹) and GLM (433.2 grain ear⁻¹, 130.10 g, 6.541 tha⁻¹, 18.00 tha⁻¹). Soil leveling results in optimal water distribution, delivering it evenly to all parts of the field. This improves plant health by allowing for the uncompromised absorption of all nutrients, enhancing photosynthesis, and promoting more uniform crop growth due to the consistent and limited water supply, thus increasing plant productivity (Lamichhane *et al.*, 2022; Kumari *et al.*, 2025).

Figure 13. Among maize varieties treatments, the SA variety greatest performance, producing 495.1 grain ear⁻¹, 139.66 g, 7.298 t·ha⁻¹, 19.200 tha⁻¹, significantly exceeding FU (398.8 grain ear⁻¹, 125.51 g, 5.914 t·ha⁻¹, 16.812 tha⁻¹), ZP (425.7 grain ear⁻¹, 131.81 g, 6.741 t·ha⁻¹, 17.928 tha⁻¹) and MA (445.4 grain ear⁻¹, 134.55 g, 6.554 t·ha⁻¹, 18.423 tha⁻¹). Increased in yield parameters is due to genetic differences among corn varieties (Nanganoa *et al.*, 2020; Januszkiewicz *et al.*, 2025).

Conclusions and Recommendations

The study demonstrated that a planting distance of SA variety significantly outperformed FU, ZP and MA across all measured growth and yield parameters.

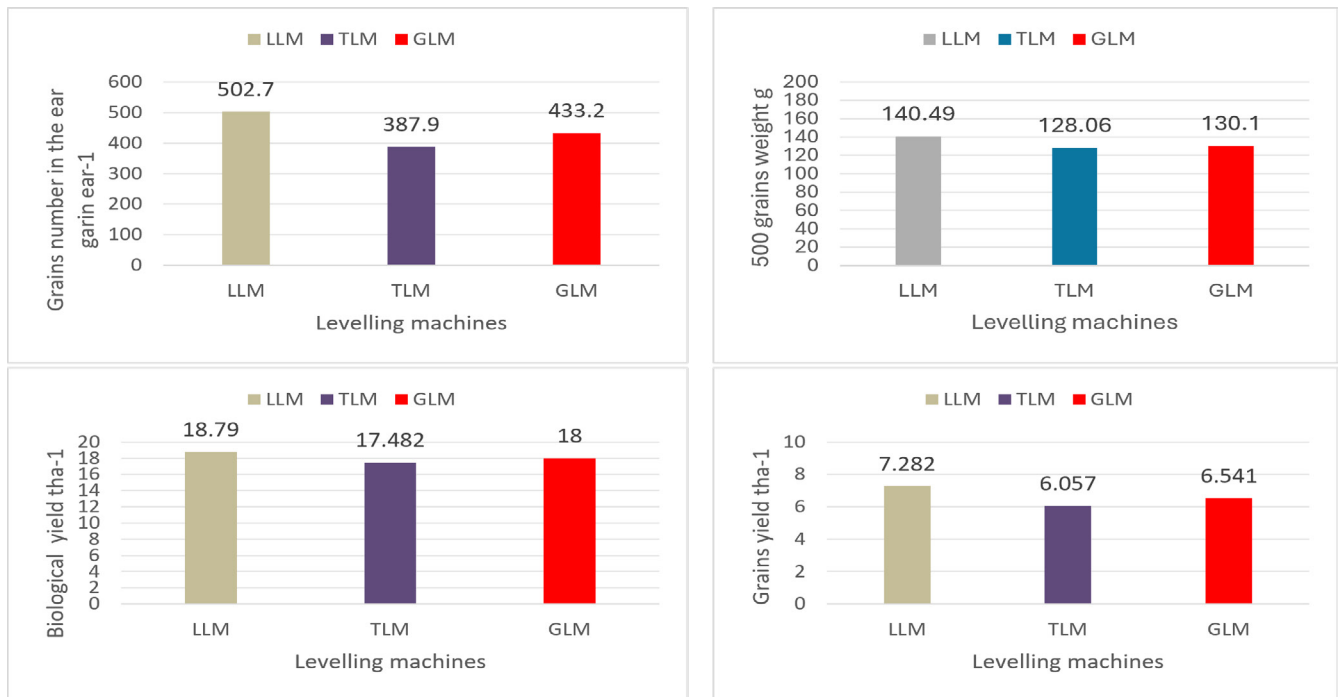


Figure 13: Effect of levelling machines on the maize yield parameters

Table 7: Variance analysis for vegetative growth and yield traits

Source	df	Plant heigh/t	Leaf area	Chlorophyll Index in .leaves	Grain num-ber.in the ear	500 grains weight	Grain. yield	Biological yield
C.Varieties	3	863.20**	49.40**	188.35**	547.96**	670.73**	217.16**	202.58**
L.Machines	2	438.44**	329.20**	147.96**	139.51**	236.96**	142.80**	484.88**
C.V*L.M	6	13.71**	15.07**	N.S	3.75*	6.00**	16.97**	12.50
C.V:- Corpe Varieties L.M:- Levelling machines								

Among levelling treatments, the LLM showed superior results compared to TLM and GLM. The high effect of Laser levelling machine with SA variety produced optimal execution, proposition this incorporation as the most effective management strategy for maize cultivation under similar conditions.

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Novelty Statement

Leveling methods are a crucial procedure for corn crops; they ensure the irrigation water even distribution, increased fertilizer efficiency, improve water use efficiency, and enhance growth characteristics and final yield.

Authors Contributions

Alaa K, Hussein: Writing - Following up on the proposed research and data collection, in addition to conducting all steps of the proposed experiment.

Mohammed.Y.Merhij Alsharifi: Validation; Writing – Review and Editing; Visualization; Validation.

Salih K. Alwan Alsharifi: Proposed the research and finalizing the manuscript and analysis and drafted the manuscript.

All authors provided critical feedback and helped to shape the manuscript.

Generative AI or AI assisted technology statement

The author's declare that no Gen AI was used in the creation of this manuscript.

Conflict of interest

The authors declares that there is no conflict of interests regarding the publication of this article .

References

- Alaamer.S.A. and Alsharifi. S.A. (2020). Affecting mechanical on some growth characteristics for maize , SYN5018 variety .Plant Archives 20(2); 1150-1155 .
- Alaamer. S, Saldani. S.M, Alsharifi S.K. (2026). Technical applications of fertilizer combinations in cotton productivity through automated sensor-based subsurface drip irrigation system. Forest Science and Technology.2026. doi;10.1080/21580103.2026.2633235
- Amer, K.Z., A. Azawi, H.A. Jabur, A.A.G. Al-Shammary, S.K. Alsharifi. 2025. The impact and analysis of mechanical factors of the mechanized unit on the production of “Vigna radiata L.” crop. Nat. Eng. Sci., 10(1): 418-424. <http://doi:10.28978/nesciences.1651195>.
- Amer, K.Z., H.A. Jebur, K. AL-Halfi. 2021. Evaluating performance indicators of mechanized unit and maize production. Ind. J. Ecol., 48 Special Issue (17): 297-300.
- Anang, B.T., E.O. Dokyi, B.O. Asante, S.A. Donkoh. 2022. Technical efficiency of resource-poor maize farmers in northern Ghana. Open Agricult., 2022: 7(1):69-78. <http://doi:10.1515/opag-2022-0075>
- Alaamer, S.A., S.K. Alsharifi, A.H. Khalil. 2023b. Sustainable use of sub-surface drip irrigation system for corn growth and productivity. AIP Confer. Proceed., 2776: 040015; <https://doi.org/10.1063/5.0135994>.
- Alaamer, A., S.k. Alsharifi, A.T. Al-Sultani. 2023a. Effect of Subsurface Drip Irrigation System and Two Levels Nitrogen Fertilizer on Corn Growth and Yield. IOP Confer. Series: Earth Environ. Sci., 1158(6): 062010. <https://doi:10.1088/1755-1315/1158/6/062010>.
- Alaamer, S.A., S.K.A. Alsharifi, N. Shtewy. 2022. Wheat parameters under influence of the depths and cultivation machinery. IOP Conf. Ser. Earth Environ. Sci., 1060(1): 012131. <http://doi:10.1088/1755-1315/1060/1/012131.2022>.
- Alaamer, S., S.K. Alsharifi, N. Shtewy. 2024. Productivity of some beard wheat cultivars under the influence of irrigation methods. IOP Confer. Series: Earth Environ. Sci., 1371(3): 032012. <http://doi:10.1088/1755-1315/1371/3/032012.2024>
- Aljibouri, M.A., S.K. Alsharifi, and S.A. Alaamer. 2022. A test of the threshing machine (LMS type) at different feed rates and speeds on some corn properties. IOP Confer. Ser. Earth Environ. Sci., 1060(1): 012133. doi: <http://doi:10.1088/1755-1315/1060/1/012133>
- Aljibouri, M.A. and S.K. Alsharifi. 2019. Evaluation of Local Design Machine for Corn Threshing. Ind. J. Ecol., 46(4): 913-920 .
- Alsharifi, S.K.A., S.A. Alaamer, A.H. Almushidy. 2022. Performance evaluation of local design machine LDSM Type on productivity and growth of wheat. IOP Confer. Ser. Earth Environ. Sci., 1060(1): 012132. <http://doi:10.1088/1755-1315/1060/1/012132>.
- Al-Sharifi, S.K., A. Alaamer, S.M.K. Saldani, 2025. Wheat crop productivity requirements using modern irrigation technology. CIGR J., 27(3): 136 – 149.
- Alsharifi, S.K.A., N. Shtewy, S.A. Alaamer. 2021. Affecting mechanical on some growth properties for corn, MAHA cultivar. IOP Conf. Seri.: Earth Environ. Sci., 735(1): 012009. <http://doi:10.1088/1755-1315/735/1/012009>
- Chen, G., L. Hu, X. Xiwen Luo, P. Wang, J. He, P. Huang, R. Zhao, D. Feng. T. Tu. 2024. A review of global precision land-leveling technologies and implements: Current status, challenges and future trends Author links open overlay panel. Comput. Electron. Agric., 220: 108901. <https://doi.org/10.1016/j.compag.2024.108901>
- Das, A., M.D. Lad and A.L. Chalodia. 2018. Effect of laser land leveling on nutrient uptake and yield of wheat, water saving and water productivity. J. Pharmacog. Phytochem., 7(2): 73-78.
- Guevara, M.D., R.A. Armindo, L.C. Timm, L.C. Faria. 2022. Examining the land leveling impacts on the physical quality of lowland soils in Southern Brazil. Soil Tillage Res., 215(5): 105217. doi: <http://doi:10.1016/j.still.2021.105217>
- Ivanova, A.M., D. Plamenov, P. Naskova, P. Yankova. 2023. Research on the effect of different types of fertilization on the maize (Zea mays L.). Annu. J. Tech. Univ. Varna. Bulg., 2023, 7: 44-51. <https://doi:10.29114/ajtuv.vol7.iss1.282>
- Januszkiewicz, R., G. Kulczycki, E. Sacała, C. Kabala. 2025. Effect of Nutrient Forms in Foliar Fertilizers on the Growth and Biofortification of Maize on Different Soil Types. Agron., 15(6): 1482. <https://doi:>

- org/10.3390/agronomy15061482
- Jing Y., C. Luo G. Liu. 2022. Multiobjective path optimization for autonomous land levelling operations based on an improved MOEA/D-ACO. *Computers and Electron. Agric.*, 197: 2022, 106995. <https://doi.org/10.1016/j.compag.2022.106995>
- Khangura. R., D. Ferris W. Wagg J. Bowyer. 2023. Regenerative Agriculture—A Literature Review on the Practices and Mechanisms Used to Improve Soil Health. *Sustain.*, 2023, 15(3): 2338; <https://doi.org/10.3390/su15032338>
- Kodua, T.T., E.E. Onumah, A. Mensah-Bonsu. 2022. Technical efficiency of improved and local variety seed maize farms in Ghana: a meta-frontier analysis. *Cogent Econ Finan.*, 10(1): 2022858. doi: <http://doi:10.1080/23322039.2021.2022858>.
- Kumari, R., P. Kumari, B. Sharma. 2025. Laser land levelling and double row planting improves productivity, water use efficiency and profitability of post monsoon sorghum in black soils. *Ind. J. Soil Conserv.*, 53(1):83-88. <http://doi:10.53550/ijsc.v53.i1.192>
- Lamichhane, P., M. Hadjikakou, K.K. Miller, and B.A. Bryan. 2022. Climate change adaptation in smallholder agriculture: Adoption, barriers, determinants, and policy implications. *Mitigat. Adaptat. Strateg. Glob. Chan.*, 27(6): 32 <http://doi:10.1007/s11027-022-10010-z>
- Martey, E., P.M. Etwire, and J.K. Kuwornu. 2020. Economic impacts of smallholder farmers' adoption of drought-tolerant maize varieties. *Land Use Poli.*, 94(1): 1-12. <http://doi:10.1016/j.landusepol.2020.104524>
- Majebele, J.J., M. Yang M. Mateen, A.A. Tola. 2025. Mechanization and maize productivity in tanzania's ruwuma region: a python-based analysis on adoption and yield impact. *Agric.*, 15(13): 1412; <https://doi.org/10.3390/agriculture15131412>
- Mdoda, L., N. Tamako, S. Lungile, L.S. Gidi, and D. Naidoo. 2025. Evaluating the impact of improved maize varieties on agricultural productivity and technical efficiency among smallholder farmers in the Eastern Cape, South Africa: an empirical analysis. *Biotechnol. Agric. Food Chain.*, 16(1): 272-304. <https://doi.org/10.1080/21645698.2025.2476667>
- Merza N.A.R., H.A. Atab, Z.H. Al-Fatlawi, S.K.A. Alsharifi. 2023. Effect of irrigation systems on rice productivity. *SABRAO. J. Breed. Genet.*, 55(2): 587-597. <http://doi.org/10.54910/sabrao2023.55.2.30>
- Mohammed, Y., H.A. Atab, S.K.A. Alsharifi. 2022. Response of corn at different levels of nitrogen fertilizer and cultivation distances. *IOP Conf. Ser.: Earth Environ. Sci.*, 1060(1): 012134. <http://doi:10.1088/1755-1315/1060/1/012134>.
- Miao, Q., J.M. Gonçalves, R. Li, D. Gonçalves, T. Levita, H. Shi. 2021. Assessment of precise land levelling on surface irrigation development. *Impact. Maize Water Product. Econ. Sustain.*, 13: 1191. <https://doi.org/10.3390/su13031191>
- Moi, S. and G. Dutta. 2020. Optimization of potassium fertilization for maize (*Zea mays* L.) in new alluvial zone of West Bengal. *Int. J. Curr. Microbiol. App. Sci.*, 9(7): 1518-1523. <http://doi:10.20546/ijcmas.2020.907.175>
- Mankhi, A.A. and H.A. Jebur. 2022. A study some technical indicators under Impact tillage depth and disk harrow angle of the compound machine. *IOP Conf. Series: Earth Environ. Sci.* IOP Conf. Series: Earth Environ. Sci., 1060(1): 012137. <http://doi:10.1088/1755-1315/1060/1/012137>
- Munialo, S., A.S. Dahlin, M.C. Onyango, W. Oluoch-Kosura, H. Marstorp, and I. Öborn. 2020. Soil and management-related factors contributing to maize yield gaps in western Kenya. *Food Ener. Secur.*, 9: e189. <http://doi:10.1002/fes3.189>
- Mueen, A.S., Alaamer, A.I. Sh. and S.K.A. Alsharifi. 2025. Effect of *Agaricus* mushroom spent residues on maize production under a drip irrigation system. *Bulgar. J. Agric. Sci.*, 31(6): 1098-1110.
- Nanganoa L.T, Ngome F.A, Suh .C, Basga S.D, (2020) Assessing soil nutrients variability and adequacy for the cultivation of maize, cassava, and sorghum in selected agroecological zones of Cameroon. *Int J Agronom* 4:1-20. <https://doi.org/10.1155/2020/8887318>
- Nawaz, M., J. Sun, S. Shabbir, W.A. Khattak, G. Ren, X. Nie, Y. Bo, Q. Javed, D. Du, and C. Sonne. 2023. A review of plants strategies to resist biotic and abiotic environmental stressors. *Sci. Tot. Environ.*, 900: 165832. <https://doi.org/10.1016/j.scitotenv.2023.165832>
- Nayyef, H.R. and H.S. Al-Laghawi. 2024. The Effect of the distance between drippers and drainage

- on the productivity and growth of tomatoes inside greenhouses. In IOP Confer. Ser.: Earth Environ. Sci., 1371(8): 082032. <http://doi:10.1088/1755-1315/1371/8/082032>
- Prasanna, B.M., J.E. Cairns, P. Zaidi, Y. Beyene, D. Makumbi, M. Gowda, C. Magorokosho, M. Zaman-Allah, M. Olsen, and A. Das. 2021. Beat the stress: Breeding for climate resilience in maize for the tropical rainfed environments. Theoret. Appl. Genet., 134(6): 1729–1752. <http://doi:10.1007/s00122-021-03773-7>
- Rácz, D., L. Szóke, B. Tóth, B. Kovács, É. Horváth, P. Zagy, L. Duzs, A. Széles. 2021. Examination of the productivity and physiological responses of maize (*Zea mays* L.) to nitrapyrin and foliar fertilizer treatments. Plant., 10(11): 2426. <https://doi.org/10.3390/plants10112426>
- Ramya, S.M.S., N. Mahesh, P. Revathi, B. Raju. 2022. Effect of laser land levelling and establishment methods on economics and water productivity of rice. Environ. Ecol., 40(1): 1-5.
- Shather, A., Shtewy, N. Alsharifi, S.K. Alwan. 2024. Wheat response to the nitrogen fertilizers in productivity. SABRAO J. Breed. Genet., 56(6): 1-12. <http://doi.org/10.54910/sabao2024.56.6>.
- Shathar, A.A., S.K.A. Alsharifi. 2023. Levelling machines and its effect on the growth characteristics and productivity for two corn cultivars. Bulg. J. Agric. Sci., 29(3): 552–563
- Shtewy, N., Ibrahim. J.H, Alsharifi. S.K. (2020). Effect of mechanical properties on some growth characteristics for wheat crop .Plant Archives,. 20 (1); 3141-3148.
- Singh, Y.P., S.T. Sandeep, S. Singh. 2021. Effect of precise levelling, tillage and seed sowing methods of pearl millet based cropping systems on productivity and soil quality in dryland area. Soil Tillage Res., 212: 105069. <https://doi.org/10.1016/j.still.2021.105069>
- Tas, T. and A. Mutlu. 2021. Morpho-physiological effects of environmental stress on yield and quality of sweet corn varieties (*Zea mays* L.). Peer J., 9: 1-22.
- Vanisree, S., Anjali K. Ch, D. Raju, S. Rajaand, M. Sreedhar. 2013. Variability, Heritability and association analysis in scented rice. J. Biol. Scient. Opin., 1(4): 347 -352. <http://doi:10.7897/2321-6328.01414>.
- Zabel, F., C. Müller, J. Elliott, S. Minoli, J. Jägermeyr, J.M. Schneider, J.A. Franke, E. Moyer, M. Dury, and L. Francois. 2021. Large potential for crop production adaptation depends on available future varieties. Glob. Chan. Biol., 27(16): 3870–3882. <http://doi:10.1111/gcb.15649>
- Zapałowska, A. and W. Jarecki. 2024. The impact of using different types of compost on the growth and yield of corn. Sustain., 16(12): 511. <https://doi.org/10.3390/su16020511>