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The Effect of Drought Stress and Mycorrhizal Biological Fertilizer Prototype on The Growth and Yield of Corn (*Zea Mays* L.)

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ABSTRACT: Drought stress is the most constraints in maize production, which play an important effect on vegetative growth and yield. This research was conducted to establish what % of the soil moisture deficit from field capacity does not diminish maize growth and yield, what dosage of inoculation with mycorrhiza spores at 40%FC results in maximisation of these and if both factors actually interact. The experiment was carried out at Greenhouse of the Experimental Farm, Faculty of Agriculture, Udayana University from April to August 2025 using a two factors factorial Randomized Block Design (RBD) with drought stress levels (100%, 80%, 60%, and 40% field capacity) and mycorrhizal inoculum doses (0, 25, 50, and 75 spores). Statistical analysis used ANOVA and Duncan's multiple range test at $p < 0.05$. The percentage of successful mycorrhizal infection under all treatments was 10–100% and brought about N, P, and K uptake. The combination of 60% field capacity and 50 spore inoculation resulted in the best root traits such as number of tips and actively foraging network area. The cob weight, ear weight, and 1000-seed weight were also significantly higher at mycorrhizal inoculation (25-75 spores). The nutrient uptake efficiency, photosynthesis activity, and drought tolerance were enhanced by mycorrhiza. The combination of 50 spores per gram of soil and 60% field capacity is proposed as an optimum condition for stimulating growth of maize.

KEYWORDS: mycorrhiza, maize, drought, field capacity, plant growth

I. INTRODUCTION

Drought stress affects approximately 41% of the world's land area, with the most extensive dry regions found in Africa, followed by Asia, North America, Oceania, South America, and Europe. Climate change significantly contributes to drought occurrences through rising global temperatures and irregular rainfall patterns, directly reducing crop productivity [1]. Indonesia, located in the tropical monsoon zone, is highly sensitive to El Niño Southern Oscillation (ENSO) anomalies, making drought a recurring annual challenge for agriculture.

Timor-Leste, which restored its independence in 2002, faces challenges in meeting food demand for its population of around 1.4 million people [2]. Corn serves as the second staple food after rice, yet its production has significantly declined in recent years due to severe droughts related to El Niño. In 2024, total corn production is estimated at only 132,000 tons, below the fiveyear average, as extreme dry conditions during the 2023–2024 planting season severely disrupted growth and yields [3]. Drought induces soil moisture deficits, reducing photosynthesis, transpiration, and nutrient uptake, ultimately leading to growth inhibition and yield loss in crops such as corn [4].

Mycorrhizae function as beneficial bioagents that enhance water and nutrient absorption, improve soil health, and increase plant tolerance to drought stress. Symbiotic associations between mycorrhizal fungi and plant roots enhance nutrient uptake efficiency, soil structure, and root protection against pathogens and toxins [5]. Biofertilizers containing mycorrhizal consortia stimulate root development and strengthen plant resilience under abiotic stress, improving growth and yield performance [6] [7]. Studies show that mycorrhizal inoculation can increase nutrient uptake by up to 30% and yield by 25% in nutrient-poor soils [8]. The integration of mycorrhiza with organic fertilizers supports sustainable agricultural systems while reducing dependency on chemical fertilizers [9].

II. MATERIALS AND METHODS

This research used a 2-factor factorial randomized block design (RAK). The first factor was drought stress (C), consisting of four levels: "(C0) control or 100% field capacity (FC) water content, (C1) 80% FC water content, (C2) 60% FC water content, (C3) 40% FC water content". The second factor was the dose of mycorrhizal spore inoculation, consisting of 4 levels, namely: "(D0) control or without mycorrhizal spore inoculation, (D1) 25 doses of mycorrhizal spore inoculum, (D2) 50 doses of mycorrhizal spore inoculum, and (D3) 75 doses of mycorrhizal spore inoculum". Thus, there were 16 combinations of treatments, each repeated 3 times, resulting in 48 experimental units. The distance between polybags was 50 cm, and 100 cm between groups. The collected data were then analyzed using analysis of variance at the 5% and 1% levels. If the interaction was significantly or very significantly, the analysis was continued using Duncan's post hoc test at the 5% level. If the interaction was not significant, each single factor was further tested using the least significant difference (LSD) analysis at the 5% level.

A. Place and time

The research was conducted at the Greenhouse of the Experimental Garden (*kebun percobaan pegok*) of the Faculty of Agriculture, Udayana University, at Jl. Pulau Moyo No. 16X, Pedungan, South Denpasar, Denpasar City, Bali. This research was conducted from April to August 2025, with the stages of activities as listed in the subchapter on the implementation of the experiment.

B. Tools and materials

The tools used were tools for collecting soil samples from the field and planting media, laboratory analysis tools for isolating spores and calculating the level of root infection by endomycorrhiza, and tools for analyzing N, P in plant tissue and available P in soil. The materials used in the study were Pioneer 21 corn seeds, endomycorrhizal propagules (zeolite containing endomycorrhizal spores), water, 60% sugar solution, Whatman No. 41 filter paper, 50% ethanol, 10% KOH, 0.05% trypan blue, lactoglycerol, polyvinyl lacto glycerol (PVLG), tissue, and distilled water, as well as materials for analyzing N, P in plant tissue, and available P content in soil.

C. Experimental design

1. Preparation of growing media

The soil used as growing media was taken from the Experimental Garden of the Faculty of Agriculture, Udayana University, at Jl. Pulau Moyo No. 16X, Pedungan, South Denpasar, Denpasar City, Bali. The soil was taken from a depth of 0-20 cm from the soil surface and cleaned of rocks and other materials. Soil samples were also taken for the purpose of analyzing physical properties (texture) and several initial chemical properties of the soil. The weight of soil used in this study was 15 kg of air-dry weight for each experimental unit (polybag). This study did not sterilize the soil, with the aim of creating natural conditions that occur in the soil, namely the interaction between microbes from the treatment and indigenous microbes in the soil.

2. Preparation of endomycorrhizal spore inoculum

The endomycorrhizal inoculum used in this study was endomycorrhizal spores of the genus Glomus isolated from the rhizosphere of corn and the roots of citrus plants originating from lowlands. The production of mycorrhizal biofertilizer began with the exploration of indigenous endomycorrhizal spores from the Experimental Garden of the Faculty of Agriculture, Udayana University, Denpasar. Three sample points were taken from each location at a distance of 30-50 cm from each location, where three points were randomly selected from each location, two samples were taken from each point (north-south or east-west), and then the three sample points were composited, noting that the soil was taken 20-50 cm from the base of the stem and 0-30 cm from the soil surface. 100 g of soil was taken from each sampling point and then composited.

After that, put the soil into a plastic bag that has been labeled accordingly. Spores were isolated using a set of Pacioni wet filters followed by the centrifugation technique, in which 100 g of soil sample was dissolved in 1,000-1,200 ml of water, then stirred evenly, and then filtered after being mixed evenly in a filter (sieve). The holes were 1 mm, 500 µm, 212 µm, 106 µm, and 53 µm, respectively, and the soil was filtered from large to small holes 2-3 times, and the remaining soil was poured back into the top sieve. Spray the top (first) filter with tap water to facilitate filtering. After the first filter is complete, continue with the next filter until the last filter and repeat 10 times for each soil sample from different collection sites. The soil remaining in the 500 µm, 212 µm, 106 µm, and 53 µm sieves is transferred to a centrifuge tube, then 25–40 ml of distilled water is added, after which it is centrifuged for 5 minutes at a speed of 2000 rpm. The centrifuged supernatant was discarded, then 60% glucose was added and centrifuged again for 1 minute at a speed of 2000 rpm. The glucose-containing supernatant was rinsed with water on a 53 µm sieve and the rinse was placed in a petri dish, then the number and type of spores were observed.

The calculation of spore count begins with wet sieving of soil from each sampling location, repeated three times using the same method, then counting the number of spores present and averaging the results. Biological mycorrhizal fertilizer is made by combining mycorrhizal isolates/genera with a carrier medium, with a composition of 50 spores from the Glomus genus and other genera per 100 g of carrier medium. The carrier medium used is volcanic sand.

Spores that are still mixed with soil particles are then purified by collecting the spores using a needle/sharp stick and placing them in a Petri dish lined with paper and containing pieces of paper numbered according to the spore dose treatment. Next, the spores on the paper pieces were transferred to a carrier medium in the form of sterilized zeolite, weighing 50 g for each treatment.

3. Planting and inoculation of mycorrhiza

Inoculation and planting are carried out simultaneously. Endomycorrhizal spores are inoculated using a layered system. Planting holes are made in the center of the polybag, 3-5 cm deep. Before planting the corn seeds, endomycorrhizal inoculum in the form of propagules (zeolite containing spores) with endomycorrhizal spore density according to the treatment is inserted into the planting hole, then covered with a thin layer of soil approximately ±1 cm. Next, the corn seeds are placed on top of the propagules that have been covered with soil. The seeds are then covered with the remaining soil and watered until sufficiently moist.

4. Determination of field capacity water content and application of drought stress treatment

Determination of drought stress levels was carried out by determining the field capacity water content for each treatment polybag. Field capacity soil water content was determined using 4 polybags filled with 15 kg of corn soil as samples. In the first stage, each polybag was watered with 5000 ml of water and left for 24 hours. The water that dripped from the bottom of the polybags was collected and its volume was calculated and then averaged. In the second and third stages, the soil was watered with 3000 ml of water and repeated twice. The soil moisture content in the corn polybags was analogized to be at field capacity by reducing the excess water volume given by the water that dripped from the bottom of the polybags. This means that to achieve field capacity soil moisture content in each polybag, it is necessary to water with an amount of water that exceeds the volume of water dripping from an average of 4 polybags used as samples and repeated twice to determine the field capacity moisture content. After calculating the average, the amount of water (A ml) required to achieve field capacity is obtained. Field capacity is determined two days before seed planting.

The application of drought stress treatments was carried out as follows: for the control level, plants were not subjected to drought stress or had a water content of 100% field capacity (A ml x 100/100), drought stress with a water content of 80% field capacity (A ml x 80/100), drought stress with a water content of 60% field capacity (A ml x 60/100) and drought stress with a water content of 40% field capacity (A ml x 40/100). Watering was carried out every two days with a fixed volume of water according to the measured field capacity.

III. OBSERVED VARIABLE

A. Plant height (cm)

Measurements are taken from the base of the plant above the surface of the medium to the longest leaf using a tape measure. Measurements are taken 14 days after planting (DAP) and then repeated every 14 days until the plants reach maximum vegetative growth or the corn plants reach the tasseling phase. This is because corn plants in the tasseling phase have reached their maximum height. Plant height measurements are expressed in centimeters (cm).

B. Number of leaves (pieces)

Counting of leaves that have grown more than 50% or leaves that have opened using hands and eyes. Observation of the number of leaves is carried out 14 days after planting (DAP) and then repeated every 14 days until the plant reaches maximum vegetative growth or the corn plant reaches the tasseling phase. This is because corn plants in the tasseling phase have reached maximum stagnant growth in their leaves.

C. Leaf chlorophyll (SPAD-unit)

Chlorophyll content in leaves was measured using a Chlorophyll Meter (SPAD Meter) on corn plants 30 days after planting (DAP). According to Rosalina (2008), the steps for calculating chlorophyll include: selecting well-grown leaves; measuring the leaf flesh using a chlorophyll meter; placing the chlorophyll meter on the upper surface of the leaf, especially on the leaf flesh, without exceeding the leaf vein; and taking measurements at the base, middle, and tip of the same leaf, with the results visible on the screen.

D. Corn cob diameter (mm)

Measured with calipers from the base of the cob to the tip. The diameter measurement can be expressed in millimeters (mm).

E. Weight of seeds per polybag (g)

Measurements were taken after harvest by shelling corn kernels per cob per plant by hand, then weighing the shelled corn kernels using scales in grams (g).

F. Number of seeds per polybag (pieces)

The number of seeds is counted after harvest by counting the total number of seeds in each cob, expressed in units of seeds.

G. Weight of plant material (g)

Measurements were taken after harvest by separating plant organs into roots, leaves, stems, and economic yields. These organs were then air-dried (until their surfaces were no longer wet) and weighed using analytical scales. The unit for fresh root weight was grams (g).

H. Root length (cm)

Total root length measurements are taken at the end of the growth cycle or after harvest using the Rizhovision Explorer device. Roots are scanned using the Rizhovision Explorer camera. The software automatically detects and sums up the length of all main and lateral roots. Results are given in centimeters.

I. Number of root tips (root)

Number of root tips measurements are taken at the end of the final growth cycle or after harvest using the Rizhobision Explorer tool. The software analyzes root thickness at various points. Number of root tips is calculated based on the average or distribution of detected root sizes. The results are presented in graphs or tables showing variations in root diameter.

IV. RESULT AND DISCUSSION

A. Result

Statistical analysis shows that the interaction between drought stress treatment and mycorrhizal spore inoculum dose has no significant effect based on the 5% ANOVA test on the plant height variable. The single factor of drought stress treatment shows significant differences, while the mycorrhizal fertilizer prototype dose shows insignificant differences. Treatment C1 or 80% field capacity moisture content had the highest plant height of 252.37 cm, which was significantly different from treatment C3 or 40% moisture content with a height of 232.13 cm. Treatment D2, or the 50spore inoculum dose treatment, tended to have the highest plant height of 250.91 cm, which was not significantly different from all other spore inoculum dose treatments.

Statistical analysis of the number of leaves variable showed no significant difference between the drought stress treatment and the mycorrhizal spore inoculum dose. The 80% field capacity drought stress treatment (C1) tended to have the highest number of leaves at 12.83, which was not significantly different from all other treatments. The 50 spores of mycorrhizal spore inoculum treatment tended to have the highest number of leaves at 12.92 leaves, which was not significantly different from all treatment levels.

Table 1. The Effect of Drought Stress and Prototype Doses of Mycorrhizal Biofertilizer on Observation Variables

Treatment	*Plant height (cm)*	*Number of leaves (pieces)*	*Leaf chlorophyll (SPAD-unit)*	*Corn cob diameter (mm)*	*Weight of seeds/polybag (g)*	*Number of seeds/polybag (seeds)*
Drought stress						
C0	245,73 a	12,42 a	35,84 b	4,50 a	204,34 a	594,08 ab
C1	252,37 a	12,83 a	38,04 ab	4,01 a	219,43 a	607,42 ab
C2	246,08 a	12,67 a	39,22 ab	4,46 a	193,99 ab	642,25 a
C3	232,13 a	12,75 a	40,15 a	4,17 a	165,36 b	514,33 b
BNT 5%	**13,49**	**0,57**	**3,90**	**0,68**	**28,90**	**108,84**

Mycorrhizal Inoculation Dose						
D0	247,50 a	12,50 a	39,38 a	4,17 a	165,58 b	428,00 b
D1	238,23 a	12,58 a	37,32 a	4,37 a	197,11 a	620,08 a
D2	250,91 a	12,92 a	38,73 a	4,11 a	206,64 a	628,50 a
D3	239,67 a	12,67 a	37,81 a	4,50 a	213,78 a	681,50 a
BNT 5%	**13,49**	**0,57**	**3,90**	**0,68**	**28,90**	**108,84**

Note: Numbers in each treatment followed by the same letter in the same column indicate no significant difference in the least significant difference (LSD) test at the 5% level.

Statistical analysis of leaf chlorophyll variables showed no significant effect on the combination of drought stress treatment and mycorrhizal spore inoculum dose. The 40% field capacity drought stress treatment (C3) had a chlorophyll content of 40.15 SPAD units, which was not significantly different from the 60% field capacity treatment of 39.22 SPAD units and the 80% field capacity treatment of 38.04 SPAD units. The treatment without the application of mycorrhizal spore inoculum (D0) tended to have the highest chlorophyll content of 39.38 SPAD units, which was not significantly different from all treatment levels.

The results of the analysis of the diameter of the corn cob showed no significant differences among all treatments. The 100% field capacity drought stress treatment tended to have the highest colobot diameter of 4.50 cm, which was not significantly different from all other treatments. The treatment with a 75spore dose of mycorrhizal inoculum tended to have the highest colobot diameter of 4.50 cm, which was not significantly different from all other treatments.

The results of the analysis of fresh weight per polybag, which had a significant effect on drought stress treatment and mycorrhizal spore inoculum dose. The 80% field capacity drought stress treatment had the highest fresh weight of seeds per polybag at 219.43 g, which was significantly different from the 40% field capacity drought stress treatment, which had a fresh weight of seeds per polybag of 165.36 g. The treatment with a 75spore inoculum dose tended to have the highest fresh seed weight per polybag at 213.78 g, which was significantly different from the treatment without mycorrhizal inoculum at 165.58 g.

The number of seeds is counted after harvest by counting the total number of seeds in each cob, expressed in units of seeds. The analysis results show that the number of seeds per polybag had no significant effect on drought stress treatment, but had a very significant effect on mycorrhizal spore inoculum dose treatment. The 60% field capacity drought stress treatment had the highest number of seeds per polybag, namely 642.25 seeds, which was significantly different from the 40% field capacity drought stress treatment, which had 514.33 seeds. The treatment with a 75spore inoculum dose had the highest number of seeds per polybag, namely 681.50 seeds, which was significantly different from the treatment without inoculum dose, which had 428.00 seeds.

The results of the analysis of weight of plant material were not significant. The 100% field capacity drought stress treatment had the highest fresh weight of 522.79 g, which was significantly different from the 60% field capacity drought stress treatment, which had a fresh weight of 450.86 g. The treatment with a dose of 50 spores of mycorrhizal inoculum tended to have the highest fresh weight of 522.18 g, which was not significantly different from all other treatments.

The results of the analysis of root length variables were not significant across all treatments. The 60% field capacity drought stress treatment tended to have the highest root length of 58.67 cm, which was not significantly different from all other treatments. The treatment without the application of mycorrhizal spore inoculum tended to have the highest root length of 57.00 cm, which was not significantly different from all other treatments.

Table 2. The Effect of Drought Stress and Prototype Doses of Mycorrhizal Biofertilizer on Observation Variables

Treatment	*Weight of plant material (g)*	*Root length (cm)*
Drought stress		
C0	522,79 a	55,67 a

C1	496,13 ab	53,17 a
C2	450,86 b	58,67 a
C3	511,86 a	54,76 a
BNT 5%	**58,84**	**6,91**
Mycorrhizal Inoculation Dose	485,21 a	57,00 a
D0		
D1	504,78 a	54,93 a
D2	522,18 a	55,00 a
D3	469,47 a	55,33 a
BNT 5%	**58,84**	**6,91**

Note: Numbers in each treatment followed by the same letter in the same column indicate no significant difference in the least significant difference (LSD) test at the 5% level.

The interaction between drought stress and mycorrhizal spore inoculum dose on the variable of root tip number showed significant results based on ANOVA at the 5% level. The combination treatment of 60% field capacity drought stress and a mycorrhizal spore inoculum dose of 50 spores (C2D2) had the highest number of root tips, amounting to 2,127.00 roots, which was significantly different from the C0D0 treatment (1,010.67 roots), C0D1 (817.67 roots), C0D2 (880.67 roots), C1D0 (1,101.33 roots), C1D1 (790.33 roots), C1D2 (1,128.00 roots), C1D3 (1,377.67 roots), C2D0 (691.67 roots), C2D1 (988.00 roots), C2D3 (940.00 roots), C3D0 (891.33 roots), C3D3 (1,156.33) (Table 5. 17). The treatment of 60% field capacity drought stress and without mycorrhizal spore inoculum had the fewest root tips. The highest to lowest decrease in root tips was 67.48% (Tabel. 3).

Table 3. Interaction between Drought Stress Treatment and Mycorrhizal Spore Inoculum Dose on Root Tip Number (roots)

	C_0	C_1	C_2	C_3
D_0	1010,67 b	1101,33 b	691,67 b	891,33 b
D_1	817,67 b	790,33 b	988,00 b	1406,00 ab
D_2	880,67 b	1128,00 b	2127,00 a	1482,33 ab
D_3	1483,67 ab	1377,67 b	940,00 b	1156,33 b

Note: Numbers followed by the same letter indicate no significant difference in Duncan's multiple range test (DMRT) at the 5% level.

B. Discussion

The results showed that the interaction between drought stress treatment and mycorrhizal inoculation dose did not significantly affect all corn growth variables. This phenomenon indicates that the role of mycorrhiza in increasing resistance to water stress has not been optimally manifested under the conditions of this experiment. The effectiveness of mycorrhizal inoculation is influenced by spore density, the suitability of the fungal strain to the host plant, and soil conditions that support root colonization [10]. Environmental factors such as water availability and soil temperature can also determine the extent to which mycorrhizal symbiosis can function effectively.

The results of the observation show that the single treatment of drought stress has a significant effect on plant height and a very significant effect on stem diameter. This physiological response illustrates that corn plants are sensitive to reductions in soil moisture content. Water deficiency causes disturbances in cell turgidity, decreased photosynthetic activity, and impaired nutrient transport, which directly affect plant morphological growth [11]. The 80% field capacity stress treatment produced plants with the

highest height and stem diameter. This condition indicates that water availability levels close to optimal field capacity can maintain turgor pressure and support cell division and elongation.

Single mycorrhizal inoculation treatments had no significant effect on all plant growth variables. The effectiveness of mycorrhiza depends on colonization ability, which is supported by the number of active spores and soil conditions. Mycorrhizal colonization requires a sufficiently long adaptation period before it can have a significant effect on plant vegetative growth [12]. The previously observed level of mycorrhizal infection indicates that hyphae, arbuscules, and vesicles have already formed, but they may not yet have reached a high enough intensity to have a noticeable impact on growth variables.

Observations of leaf number, chlorophyll content, and relative water content showed no significant effect on all treatments. These variables reflect the physiological activity of plants, which is closely related to the process of photosynthesis and leaf water status. These results are in line with the effects of mycorrhiza on chlorophyll content and photosynthetic efficiency only became significant after colonization reached more than 60% of the root surface [13]. The relatively low spore dose treatment and short observation period were likely the main reasons for the lack of significant differences in these variables. Relative water content analysis shows that the 60% field capacity treatment yielded the highest value, indicating the plant's ability to adapt to moderate drought conditions. Mycorrhizae are known to improve water balance in plant tissues by increasing water absorption by external hyphae [14]. The presence of active hyphae can expand the water absorption zone and increase water use efficiency in corn plants. More efficient water absorption helps maintain plant physiological stability, although in this study the effect was not statistically significant.

The combination treatment of 60% field capacity drought stress and inoculation with 50 mycorrhizal spores (C2D2) produced the highest number of root tips compared to other treatments. This response indicates that moderate drought stress intensity can trigger adaptive root activity and increase mycorrhizal colonization efficiency. Plants tend to adapt by increasing lateral root growth and root tip number to expand water uptake. This mechanism is known as the plasticity response of the root system under drought stress [15]. Mycorrhizal inoculation enhances this response through the extension of hyphae, which act as an extension of the plant root system.

Other variables such as root length showed no significant effect. This condition indicates that the effect of mycorrhiza on root growth is more qualitative than quantitative in the early stages of colonization. The efficiency of mycorrhizal colonization is not always reflected in an increase in root biomass, but rather in the optimization of root physiological functions such as water and nutrient absorption [16]. The lack of significant differences in fresh and dry root weight indicates that plants prioritize water absorption efficiency over root mass growth when experiencing drought stress.

The effectiveness of mycorrhiza was evident in the combination treatment of 80% field capacity stress with an inoculum dose of 25–50 spores, which produced the highest seed weight. Moderate stress conditions allowed plants to utilize adaptive mechanisms supported by mycorrhiza, such as increased synthesis of osmolytes, antioxidants, and photosynthetic enzyme activity. Mycorrhizal colonization strengthens root cell membrane integrity and improves the efficiency of photosynthate translocation to seeds [17]. Arbuscular activity in root tissues accelerates nutrient and water exchange between plants and fungi, which has implications for increased seed yield [16]. The physiological response of plants to the combination of mycorrhiza and moderate drought produces a balance between vegetative growth and yield formation. Mycorrhiza increased leaf chlorophyll content and photosynthesis rates by 15–25%, which directly impacted the increase in 1,000-seed weight [18]. Mycorrhizal colonization also increases phosphorus availability in the rhizosphere up to threefold through the activity of fungalproduced phosphatase enzymes [19]. Increased phosphorus levels improve seed formation and increase seed weight per plant.

The efficiency of mycorrhiza in increasing yields is not solely through an increase in vegetative biomass, but through the optimization of carbon and nutrient use towards reproductive organs. Mycorrhizal plants had a 22% higher carbon translocation efficiency than controls, so that more photosynthetic assimilation was allocated to seed formation [15], in line with mycorrhizal colonization increases the source-sink ratio, thereby increasing seed productivity even though vegetative growth is relatively the same [13]. Mycorrhizal treatment also affects the physiological quality of seeds. Mycorrhizal plants had higher 1,000-seed weight and more stable seed moisture content at harvest. Mycorrhiza increases seed filling through the regulation of carbohydrate metabolism and increased invertase activity in endosperm tissue, indicating that mycorrhiza plays a role not only in maintaining quantitative yield but also in seed physiological quality [20]. The overall results of the study show that mycorrhiza has great potential in dryland farming systems. A dose of 25–75 spores can increase grain yield, cob weight, and water efficiency in mild to moderate drought conditions. The strategy of utilizing mycorrhiza is one of the effective biological solutions to reduce the impact of drought on corn productivity. These findings reinforce global research results stating that AMF is an important biological agent in sustainable agriculture [21].

V. CONCLUSIONS

The level of water reduction that does not affect corn growth and yield is in the range of 60–80% of field capacity. Severe drought (40% of field capacity) has been shown to significantly reduce morphological parameters and yield due to physiological disturbances and decreased enzymatic activity. The optimal inoculation dose of mycorrhizal spores that can increase corn growth and yield is in the range of 25–50 spores per polybag. Inoculation at this level results in optimal root colonization, characterized by the formation of arbuscules, external hyphae, and vesicles that are active in increasing phosphorus, nitrogen, and potassium uptake. The effectiveness of mycorrhiza at this dose supports an increase in cob weight, 1,000-seed weight, and water use efficiency without causing colonization saturation, which can reduce symbiotic performance. The interaction between water content reduction and mycorrhizal inoculation dose significantly affected several corn growth and yield parameters, particularly cob weight, ear weight, 1,000-seed weight, network area, and root tip number. The combination of 60–80% field capacity treatment with a 25–50 spore inoculation dose showed the best synergy in improving plant adaptation to drought stress. Mycorrhizal colonization strengthens the root system, expands the nutrient absorption zone, and maintains the physiological balance of the plant, so that productivity remains stable even when there is a reduction in soil water.

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