

BUKTI KORESPONDENSI :

<https://www.scopus.com/sources.uri>

The screenshot shows the Scopus Sources search interface. The search results list one source: Applied Ecology and Environmental Research. The table below summarizes the data for this source.

Source title	CiteScore	Highest percentile	Citations 2018-21	Documents 2018-21	% Cited
1 Applied Ecology and Environmental Research	1.5	40% 220/370 Agronomy and Crop Science	3,712	2,401	54

Additional information visible in the screenshot includes a notification about the improved CiteScore methodology, filter options, and display settings.

<https://www.scopus.com/sourceid/100147015>

The screenshot displays the source details for Applied Ecology and Environmental Research. The following table summarizes the key metrics and information shown on the page.

Metric	Value
CiteScore 2021	1.5
SJR 2021	0.232
SNIP 2021	0.400

Other details include: Scopus coverage years (2003, from 2005 to Present), Publisher (Szent Istvan University), ISSN (1589-1623), E-ISSN (1785-0037), and Subject area (Agricultural and Biological Sciences: Agronomy and Crop Science).

<https://www.aloki.hu/>

The screenshot shows the homepage of the journal 'Applied Ecology and Environmental Research'. The title is prominently displayed in a large, stylized font. Below the title, the journal's DOI (10.15666/aeer) and ISSN numbers (1785 0037 for online, 1589 1623 for print) are listed. A left sidebar contains a list of links for authors, including instructions, manuscript preparation, and citation information. The main content area provides details about the journal's publisher (ALÓKI Applied Ecological Research and Forensic Institute Ltd., Budapest, 2010-), previous publishers (Penkala Ltd., Budapest, 2003-2009), and its supporters, including the Research Institute of Multidisciplinary Ecotheology of John Wesley Theological College (2021-), the Department of Environmental Security of John Wesley Theological College (2020-), the Association of Natural Research of Gödöllő (2017-), and the Adaptation to Climate Change Research Group of the Corvinus University of Budapest.

SUBMIT : 24 Februari 2022

The screenshot shows a Yahoo! Mail inbox. The selected email is from 'Applied Ecology <aeerjournal@gmail.com>' to 'Achmad Fatchul Aziez', dated Thursday, February 24 at 3:37 PM. The email body contains the following text: 'Dear Author, Thank you for your submitted manuscript. Your submission number is: 13439. Please use this registration number in any case of communication with the journal. We will contact you within a few weeks regarding the further procedures. Best regards, Technical Editors Applied Ecology and Environmental Research Open Access International Scientific Journal http://www.aloki.hu/'. The interface includes a navigation bar with various categories like Home, Mail, News, Finance, Sports, Entertainment, Life, Search, Shopping, and Yahoo Plus. A sidebar on the left shows the 'Compose' button and a list of folders including Inbox (431), Unread, Starred, Drafts (30), Sent, Archive, Spam, Trash, and Less. A right sidebar features an advertisement for 'Tower of Fantasy' with the text 'Separuh mimpi, separuh tujuan' and 'Siapkan senjata & jalankan misi'.

BUKTI SUBMIT

THE EFFECT OF DROUGHT STRESS ON THE GROWTH AND YIELD OF SOYBEAN (*GLYCINE MAX L.*)

AEER_13439

(Received; accepted)

Abstract. Drought stress affects the growth and yield of soybean. Stunted growth will have an impact on yield. This study aims to determine the effect of drought stress on the growth characteristics and grain yield of soybean. This research uses a randomized complete block design (RCBD) and three replications. The first factor was soil moisture content consisting of three levels, i.e., 100%, 75%, 50%, and 25% field capacity. The second factor was growth stage consisting of three kinds, i.e., the vegetative active, flowering, and seed filling stages. The results showed that soil moisture content below 75% field capacity reduced the leaf area index (LAI), leaf area duration (LAD), specific leaf area (SLA), net assimilation rate (NAR), crop growth rate (CGR), the seed weight per 100 seeds, and the weight of the seeds per plant. In seed filling stage is more sensitive to water shortages than the vegetative or flowering stages. At all stages of growth, a higher drought level equals a higher decrease in soybean growth and yield. For future research, we suggest that soybean planting utilize 100% field capacity.

Keywords: *field capacity, grain, growth analysis, growth phase, soil moisture*

Introduction

Drought stress has significantly reduced agricultural productivity worldwide, including soybean (*Glycine max L.*) seeds (Buezo et al. 2019). In Indonesia, soybeans are often grown as an intercropping plant after rice and are widely cultivated in times of drought. Soybean production during the dry season is constrained by limited water availability. Therefore, some or all stages of plant development are affected by drought.

Along with the increase in air temperature caused by global warming, drought also harms soybean production, decreasing seed yields (Daryanto et al., 2015). Ahmed et al. (2010) stated that the lack of water increased the canopy's root ratio to increase water utilization. Thu et al. (2014) found that roots were distributed to the topsoil zone if sufficient water was available. If not, roots would grow and develop in deeper soil.

In general, drought stress affected the vegetative and generative phases of plants and resulted in a yield decrease. The reproduction phase was sensitive to drought stress as it directly affects the flowering and pod filling stages (Hatfield et al., 2011). Ghassemi-Golezani et al. (2010) found that drought stress decreased the number of flowers and filled pods in the reproductive phase. The plant can not effectively distribute carbohydrates from leaves to pods, reducing the amount and size of produced seeds.

Alqudah et al. (2011) and Ozalkan et al. (2010) stated that the LAI, NAR, and CGR continued to increase until the pod filling stage. Over its entire vegetation period, chickpeas had a reduced LAD, specifically into their initial pod arrangement while their biomass increases. LAD positively correlated with the biomass and yield of chickpeas in Southern Spain (López-

Bellido et al., 2008). In several varieties, Ozalkan et al. (2010) found that CGR was greater at the pod filling stage compared to earlier stages. Furthermore, Ozalkan et al. (2010) stated that the growth process, namely CGR, RGR, and NAR, directly affected economic gains, as seen in greater grain yields. In plants, researchers had identified development parameters such as optimum LAI and CGR during the flowering stage as the main determinants of yield (Baloch et al., 2006). The vegetative and generative growth stages of soybean consisted of emergence, first trifoliolate, second trifoliolate, third to fifth trifoliolate, sixth trifoliolate, beginning bloom, full bloom, beginning pod, full pod, beginning seed, full seed, beginning maturity, and full maturity (Nleya and Sexton, 2019).

Maleki et al. (2013) examined soybean plants undergoing drought stress treatment at various stages of growth in several varieties. The results showed that drought stress and variant significantly affected plant height, fertile pods, harvest index, oil and protein percentages. Under drought stress, the seed filling and flowering stages showed the lowest production with a yield of 2,682 kg.ha⁻¹ and 2,918 kg.ha⁻¹, respectively. Luo et al. (2016) examined cotton plants in four growth phases given light and moderate water stress. The results showed that the water deficit significantly reduced leaf water potential, net photosynthetic rate, and stomatal conductance in cotton. In this study, there was no clear mention of moisture levels for mild or moderate stress.

Marchese et al. (2010) examined *Artemisia annua* L. plants with five water deficit treatments, namely irrigated, 14, 38, 62, 86 hours, and without irrigation. The results showed that water deficit limits plant growth but can trigger the accumulation of secondary metabolites. Water deficits of 38 and 62 hours increased leaf artemisinin content. However, only the 38-hour treatment caused a significant increase in leaf and plant artemisinin without negatively affecting plant biomass production. In a greenhouse study, Samarah et al. (2009) compared four wheat varieties with a soil moisture content of 75%, 50%, and 25% field capacity. This research did not attempt to determine the optimal moisture content for growth; it compared variants and their relation with drought and yield. Zulfiqar et al. (2020) studied two varieties of marigolds under the stress of 60% soil moisture content and 40% field capacity. The results showed that leaf thickness decreased at 40% soil moisture field capacity and the Inca variety was more resistant than the Bonanza variety to water stress.

Sacita et al. (2018) researched two varieties in their vegetative and generative phases, with irrigation intervals of 2.5 and 10 days. The results showed that water stress in the vegetative stage had no significant effect on soybean production. Soybean plants adapt to water stress by reducing the leaf number, leaf area, and stomata openings and responding to a motion by folding the leaves.

Many previous studies examined the effect of drought stress on plant morphological characters and only a few examined the effect of drought stress on plant physiological characters, especially soybeans, and this physiological observation was only observed at harvest time. Research that has not been carried out is to examine drought stress on physiological characters and soybean yields at various growth stages. There has been no attempt to examine the effects of drought stress at various stages of growth on the growth characteristics and yield of soybean. This research will attempt to determine the stage of soybean growth most affected by water stress which can impact soybean yield. Based on the description above, this research aims to determine the effect of drought stress on the growth characteristics and yield of soybean.

Materials and methods

Study area

The team conducted the research in a plastic house in Demangan, Sambu, Boyolali, Central Java, Indonesia, from August to November 2020 with alfisol soil. The Department of Food Crop Agriculture, Grobogan, Central Java, Indonesia, provided the Grobogan variant of the soybean seeds. A geographical position was between 110° 22'-110° 50' east longitude and between 7°7'-7°36' south latitude with a height of 184 m above sea level (ASL), and the average rainfall is 139 mm month⁻¹ and the average temperature 26-32°C.

Experimental design

This research was arranged in a randomized completely block design (RCBD) with two factors and three replications. The first factor was soil moisture content consisted of four levels, i.e., 100%, 75%, 50%, and 25% field capacity. The second factor was the growth stage, which consisted of three kinds, i.e., the active vegetative, flowering, and pod filling stages. In this study, there were 12 treatment combinations. Each treatment combination was three times replications, and each replication consisted of four plant samples. Overall, the study required 144 polybags.

Research procedures

Before the research, the team conducted a chemical analysis of the soil used for the research substrate. The results showed an H₂O pH of 6.38 (slightly sour), C concentration of 3.60% (very high), organic matter concentration of 6.22% (very high), total N concentration of 0.15% (low), available P of 8.10 ppm (very high), available K of 0.79 me/100 g (high) and CEC value of 26.12 me/100 g (high).

The media used was 10 kg of alfisol soil and manure at a ratio of 1:1. After being prepared and mixed, the media filled a 35 × 35 cm polybag as a medium for soybean seeds. NPK Phonska and SP-36 fertilizers at a dose of 100 and 75 kg ha⁻¹, respectively, were applied at planting time and five weeks after planting.

The planting utilized a depth of 3 cm, with each polybag containing three soybean seeds. The selection process took 14 days which selected one plant. Thinning was conducted at 1 week after planting (WAP), leaving one plant per polybag. During the research, no weeds, pests, or diseases caused significant problems. Therefore, the team did not carry out control measures. According to the treatment, water application must reach a soil moisture content of 100%, 75%, 50%, and 25% field capacity by accounting for the growth stages, namely the active vegetative, flowering, and pod filling stages. Harvesting was conducted 90 days after planting (DAP).

Measurement

The parameters observed were the leaf area index (LAI), leaf area duration (LAD), specific leaf area (SLA), net assimilation rate (NAR), crop growth rate (CGR), and the weight of the seeds per plant. The data observation was conducted in 4, 6, 8, and 10 WAP. LAI was calculated from the ratio between the total leaf surface area per unit ground area. LAI was determined by the intensity of radiation intercepted divided planting spacing. LAD is the time a leaf could last on the plant. LAD was calculated from leaf area (cm²) divided by time (week)

NAR is the ability of plants to produce dry materials that assimilate each unit of leaf area at each unit of time, which is stated in Eq. 1.

$$NAR = \frac{W_2 - W_1}{t_2 - t_1} \times \frac{\ln LA_2 - \ln LA_1}{LA_2 - LA_1}, \text{ (in g.cm}^{-2}\text{.weeks}^{-1}\text{)} \quad (\text{Eq. 1})$$

CGR is the ability of plants to produce dry materials that assimilate each unit of land area at each unit of time, which is stated in Eq. 2.

$$CGR = \frac{1}{G} \times \frac{W_2 - W_1}{t_2 - t_1}, \text{ (in g.m}^{-2}\text{.weeks}^{-1}\text{)} \quad (\text{Eq. 2})$$

Description: W1 = total dry weight per plant at the time of t1. W2= Total dry weight per plant at the time of t2. LA1= Total leaf area per plant at the beginning. LA2 = Total leaf area per plant at the time of t2. G = the area of land overgrown with plants. t1 = harvest time in the beginning. t2 = harvest time in the end.

Statistical analysis

Observational data were analyzed using analysis of variance (ANOVA) with the SAS 9.1 program. If the treatment had a significant effect, then to know the difference between treatments was done using Duncan's new multiple range tests (DMRT) at 5% significance level (Gomez and Gomez 1984).

Results

Leaf area index

The ANOVA showed a significant interaction between soil moisture and growth rate on LAI at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average LAI in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 1.

Table 1. LAI at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10 -12 WAP

Soil moisture (% field capacity)	Growth stage	LAI			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active vegetative	0.75 ab	1.05 ac	1.20. b	0.88 ab
	Flowering	0.85 a	1.21 ab	1.24 ab	0.90 ab
	Seed filling	0.69 ab	1.34 a	1.34. a	0.95 a
75	Active vegetative	0.73 ab	1.04 a-c	1.26 ab	0.87 ab
	Flowering	0.70 ab	0.99 b-d	1.22 ab	0.86 ab
	Seed filling	0.70 ab	1.02 a-c	1.26 ab	0.90 ab
50	Active vegetative	0.59 b	0.87 b-d	1.22 ab	0.86 ab
	Flowering	0.61 b	0.86 b-d	1.20 b	0.83 bc
	Seed filling	0.72 ab	0.83 cd	1.15 bc	0.72 d
25	Active	0.63 ab	0.84 cd	1.23 ab	0.81 b-d

	vegetative				
	Flowering	0.34 c	0.82 cd	1.15 bc	0.74 cd
	Seed filling	0.63 ab	0.67 d	1.06 c	0.71 d
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. LAI = leaf area index WAP = week after planting

Table 1 shows that at 4-6, 6-8, 8-10, and 10-12 WAP, the highest LAI occurred at a soil moisture content of 100% field capacity during the seed filling stage. The lowest LAI occurred at a soil moisture content of 25% field capacity during the seed filling the stage at 6-8, 8-10, and 10-12 WAP.

Leaf area duration

The ANOVA on LAD showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average LAD in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 2.

Table 2. LAD at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10-12 WAP

Soil moisture (% field capacity)	Growth stage	LAD (cm ² week ⁻¹)			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active	959 ab	1318 a-c	1258 b-d	1220 ab
	vegetative				
	Flowering	1021 a	1505 ab	1271 a-d	1140 bc
75	Seed filling	926 ab	1596 a	1362 a	1268 a
	Active	944 ab	1303 a-c	1317 ab	1118 b-d
	vegetative				
50	Flowering	895 ab	1249 a-c	1260 b-d	1239 ab
	Seed filling	913 ab	1281 a-c	1305 ab	934 ef
	Active	833 ab	1079 bc	1256 b-d	1129 b-d
25	vegetative				
	Flowering	794 b	1013 c	1286 a-c	1037 c-e
	Seed filling	824 ab	1032 c	1190 cd	915 ef
25	Active	814 ab	1005 c	1221 b-d	1008 de
	vegetative				
	Flowering	533 c	1007 c	1244 b-d	929 ef
	Seed filling	865 ab	898 c	1171 d	845 f
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. LAD = leaf area duration, and WAP = week after planting

Table 2 shows that LAD has the same pattern as LAI. The highest value occurred at a soil moisture content of 100% field capacity during the seed filling stage, while the lowest occurred at a soil moisture content of 25% field capacity during the seed filling stage at 6-8, 8-10, and 10-12 WAP.

Specific leaf area

The ANOVA on SLA showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average SLA in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 3.

Table 3. SLA at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10 -12 WAP

Soil moisture (% field capacity)	Growth stage	SLA (cm ² .g ⁻¹)			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active vegetative	287.33 ab	230.00 ab	246.67 ab	225 a-d
	Flowering	321.67 a	237.00 ab	241.67 b	254 ab
	Seed filling	298.33 ab	270.00 a	313.67 a	278 a
75	Active vegetative	275.00 ab	232.33 ab	272.00 ab	245 a-c
	Flowering	291.67 ab	225.67 ab	241.33 b	169 d
	Seed filling	283.33 ab	230.67 ab	272.33 ab	220 a-d
50	Active vegetative	282.33 ab	236.00 ab	268.00 ab	224 a-d
	Flowering	288.67 ab	219.67 b	231.33 b	192 b-d
	Seed filling	280.33 ab	225.67 ab	249.67 ab	162 de
25	Active vegetative	287.67 ab	224.33 ab	241.00 b	184 cd
	Flowering	199.00 c	221.67 b	246.67 ab	167 d
	Seed filling	264.33 b	169.00 c	156.33 c	102 e
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. SLA = specific leaf area WAP = week after planting

Table 3 shows that the highest specific leaf area during 4-6, 6-8, 8-10, and 10-12 WAP was at a soil moisture content of 100% field capacity during the seed filling stage. Meanwhile, the lowest SLA occurred at a soil moisture content of 25% field capacity during the seed filling the stage at 6-8, 8-10, and 10-12 WAP. Drought stress is most detrimental to soybean plants during generative growth, especially during the seed filling stage

Net assimilation rate

The ANOVA on NAR showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average NAR in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 4.

Table 4. NAR at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10-12 WAP

Soil moisture (% field capacity)	Growth stage	NAR (x 10 ⁻⁵ g.cm ⁻² .week ⁻¹)			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active	332.33 bc	306.67 ab	168.33 ab	24.47 c-e
	vegetative				
	Flowering	560.99 a	243.67 a-d	151.00 a-c	317.26 a-d
75	Seed filling	502.00 ab	372.00 a	208.33 a	219.47 e
	Active	451.43 ab	277.00 a-c	144.67 bc	277.15 b-e
	vegetative				
50	Flowering	464.67 ab	283.67 a-c	192.33 ab	228.48 de
	Seed filling	480.43 ab	304.00 ab	160.33 a-c	229.36 de
	Active	402.33 ab	254.67 a-d	164.33 ab	286.29 b-e
25	vegetative				
	Flowering	445.67 ab	261.33 a-d	135.00 bc	298.46 b-e
	Seed filling	384.67 a-c	373.33 cd	141.33 bc	351.27 ab
25	Active	417.67 ab	189.00 b-d	139.67 bc	320.32 a-c
	vegetative				
	Flowering	194.33 c	259.67 a-d	155.00 a-c	301.68 b-e
	Seed filling	340.00 bc	137.67 d	101.00 c	387.76 a
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. NAR = net assimilation rate WAP = week after planting

Table 4 shows that during 4-6 WAP, the NAR value was highest at a soil moisture content of 100% field capacity during the flowering stage, while the lowest was at a soil moisture content of 25% field capacity during the flowering stage. Conditions during 6-8 and 8-10 WAP had the same pattern as previous observations. Conditions during 10-12 WAP contradict previous results, as the NAR value was highest at a soil moisture content of 25% field capacity during the seed filling stage, while the lowest was at a soil moisture content of 100% field capacity during the seed filling stage.

Crop growth rate

The ANOVA on CGR showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average CGR in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 5.

Table 5. CGR at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10-12 WAP

Soil moisture (% field capacity)	Growth stage	CGR ($\times 10^{-5}$ mg.cm ⁻² .week ⁻¹)			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active	272.33 ab	271.00 bc	193.67 a-c	330.85 bc
	vegetative				
	Flowering	318.00 a	300.00 a-c	185.67 a-d	252.36bc
75	Seed filling	267.67 ab	418.00 a	234.67 a	188.62 c
	Active	274.33 ab	321.67 ab	186.00 a-d	233.82 bc
	vegetative				
50	Flowering	246.33 a-c	303.67 a-c	227.33 ab	251.48 bc
	Seed filling	252.33 a-c	311.67 a-c	186.33 a-d	232.69 bc
	Active	240.33 bc	239.67 bc	200.00 a-c	270.26 ab
25	vegetative				
	Flowering	189.33 c	238.67 bc	182.67 b-d	246.47 bc
	Seed filling	276.33 ab	242.00 bc	154.00 cd	272.62 ab
	Active	220.67 bc	255.00 bc	168.00 cd	256.38 bc
	vegetative				
	Flowering	187.67 c	224.33 bc	154.67 cd	236.78 bc
	Seed filling	223.00 bc	182.00 c	141.00 d	334.32 a
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. CGR = Crop Growth Rate and WAP = week after planting

Table 5 shows that 4-6, 6-8, and 8-10 WAP showed the same pattern, namely having the highest Crop Growth Rate (CGR) at 100% soil moisture content during the seed filling stage while having the lowest at a soil moisture content of 25% during the seed filling stage. However, conditions during 10-12 WAP had the opposite pattern to previous observations. The CGR value was highest at a soil moisture content of 25% field capacity during the seed filling stage, while the lowest was at a soil moisture content of 100% field capacity during the seed filling stage. NAR shows the same pattern, meaning that CGR and NAR are related.

Seeds weight

The ANOVA on seed weight per 100 seeds and per plant showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average seed weight per 100 seeds and per plant is shown in Table 6.

Table 6. Weight of 100 seeds (g) and weight of seeds per plant (g) at various levels of drought and growth stages

Soil moisture (% field capacity)	Growth stage	Seed weight	
		g 100 seeds ⁻¹	g plant ⁻¹

100	Active vegetative	14.013 a	4.285 a
	Flowering	13.580 a	3.594 ab
	Seed filling	13.187 a	3.837 ab
75	Active vegetative	13.183 a	.315 b
	Flowering	13.793 a	3.565 ab
	Seed filling	10.353 c	2.994 bc
50	Active vegetative	11.787 b	3.303 b
	Flowering	13.607 a	2.941 bc
	Seed filling	7.293 d	2.231 cd
25	Active vegetative	11.477 bc	2.174 cd
	Flowering	11.890 b	2.332 c
	Seed filling	5.307 c	1.441 d
Interaction treatments		(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels.

Table 6 shows that the highest seed weight per plant occurred at a soil moisture content of 100% field capacity in the active vegetative stage, while the lowest was at a soil moisture content of 25% field capacity in the seed filling stage. This pattern is identical to the pattern of the weight of 100 seeds.

Discussion

Regardless of drought stress, the LAI value increased from 4-6 to 6-8 and from 6-8 to 8-10 WAP. However, from 8-10 to 10-12 WAP, the LAI value decreased. This decrease was due to the harvest age, in which the leaves begin to experience senescence. In this research, 8-10 WAP showed the highest LAI value. However, Özalkan et al. (2010) found the highest LAI and LAD values during the linear vegetative growth stage.

The four observation periods showed that rather than the growth stage, drought stress determines the value of LAI. Drought stress was inversely proportional to the LAI value. One of the functions of water was to support the photosynthetic process. With decreased photosynthesis, the size of the leaves will also decrease. The disruption in cell division and enlargement in drought stress conditions was due to loss of turgor and decreased photosynthesis and energy supply caused a decrease in leaf area (Talbi et al. 2020).

Hatfield et al. (2011), stated that drought stress affected the growth of the vegetative and generative stages of plants, decreasing crop yields. However, the reproductive stage was highly sensitive to drought stress as it directly affected the flowering and pod filling stages. The linear vegetative growth stage showed the highest LAI and LAD values (Özalkan et al. 2010). The NAR represents the ability of plants to produced dry matter (Da-yong et al., 2012). The NAR value showed a positive correlation with RGR (Li et al., 2016). Therefore, NAR can act as the main determinant of the RGR value. In general, SLA increases from initial growth to 10 WAP, after which it decreased as leaves begin to experience senescence. Plants with severe drought did not experience an increase in SLA, especially in the vegetative or seed filling stages. One of

the functions of water is to accommodate photosynthesis. With low photosynthesis activity, leaf size will not increase at its usual rate.

Regardless of drought stress, the CGR value increased from 4-6 WAP to 6-8 WAP and decreased from 6-8 to 8-10 WAP. The plants have entered the seed filling stage from 6-8 to 8-10 WAP, decreasing dry weight. According to Anjum et al. (2014), CGR will be continued to increase until the middle growth stage and decrease towards maturity.

During rice plant growth, NAR and RGR generally show an increase (height) at the beginning of the growth phase, then decrease rapidly with plant age (Sridevi and Chellamuthu 2015). At 40-50 days after planting, NAR had a weak positive correlation with grain yield. The flowering stage showed the highest NAR and CGR scores (Ozalkan et al., 2010). Ozalkan et al. (2010) stated that there is a significant correlation among most of the growth parameters during all growth stages.

One of the functions of water is to translocate the assimilate from the leaf (source organ) to the seed (sink organ). A lack of water will hamper the seed filling process. Drought stress affects seed production and quality (Alqudah et al., 2011). Ghassemi-Golezani et al. (2010) stated that drought stress experienced during the reproductive phase decreases flowers and filled pods. This stress inhibits the distribution of carbohydrates from the leaf to the pod, resulting in a decrease in the number and size of seeds (Alqudah et al., 2011).

A considerable lack of water will reduce the quality and quantity of soybean production. Hatfield et al. (2011) stated that drought stress affected the growth of plants during the vegetative and generative stages, which ultimately resulted in a decrease in crop yields. The occurrence of water shortages and high temperatures at the beginning of the flowering to the ripening stage accelerated the pod filling period and reduces yield weight (Kobraei et al., 2011).

Plant morpho-physiological characteristics, such as leaf thickness and plant growth rates affected productivity, considering that these characteristics affected photosynthesis speed. In long periods, a high seed filling rate will produce a high seed weight as long as the seed as a sink can accommodate a high assimilation rate. Conversely, a large enough sink with a low assimilation rate can result in a seed void. Source limitations often occur during the seed filling stage but sink limitations can occur even in non-stress conditions (Egli 1999). Production had a significant positive correlation with the net photosynthetic rate (NAR) (Da-yong et al., 2012). Drought stress reduced yield of soybean. A soil moisture content of 80 and 60% field capacity reduced the yield of soybean genotypes by 15.7% and 23.4%, respectively (Patriyawaty and Anggara 2020). Daryanto et al. (2015) stated that yield reduction was generally higher in legumes experiencing drought during their reproductive stage than during their vegetative stage. Sridevi and Chellamuthu (2015) found that higher grain yields reflected satisfactory dry matter production, LAI, LAD, CGR, NAR, and RGR values.

Conclusion

In conclusion, our study found that soil moisture content at below 75% field capacity reduced the LAI, LAD, SLA, NAR, CGR, the seed weight per 100 seeds, seed weight per plant. In seed filling stage is more sensitive to water shortages than the vegetative or flowering stages. At all stages of growth, a higher drought level equals a higher decrease in soybean growth and yield. For future research, we suggest that soybean planting utilize 100% field capacity.

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REFERENCES

- [1] Ahmed, S. U., Senge, M., Ito, K., Adomako, J. T. (2010): The effect of deficit irrigation on root/shoot ratio, water use efficiency and yield efficiency of soybean. – *Journal of Rainwater Catchment Systems* 15(2): 39–45
- [2] Alqudah, A. M., Samarah, N. H., Mullen, R. E. (2011): Drought stress effect on crop pollination, seed set, yield, and quality. In *Alternative Farming Systems, Biotechnology, Drought Stress, and Ecological Fertilisation, Sustainable Agriculture Reviews* 6: 193–213.
- [3] Anjum, S. A., Ashraf, U., Tanveer, M. (2014): Morphological and phenological attributes of maize affected by different tillage practices and varied sowing methods. *American Journal of Plant Sciences* 5: 1657-1664.
- [4] Baloch, M. S., Awan, I. U., Hassan, G. (2006): Growth and yield of rice as affected by transplanting dates and seedlings per hill under high temperature of Dera Ismail Khan, Pakistan. – *Journal of Zhejiang University* 7(7): 572–579.
- [5] Buezo, J., Sanz-Saez, Á., Moran, J. F., Soba, D., Aranjuelo, I., Esteban, R. (2019): Drought tolerance response of high-yielding soybean varieties to mild drought: physiological and photochemical adjustments. – *Physiologia Plantarum* 166(1): 88–104.
- [6] Da-yong, L., Zhi-an, Z., Dian-jun, Z., Li-yan, J., Yuan-li, W. (2012): Comparison of net photosynthetic rate in leaves of soybean with different yield levels. – *Journal of Northeast Agricultural University* 19(3): 14–19.
- [7] Daryanto, S., Wang, L., Jacinthe, P. A. (2015): Global synthesis of drought effects on food legume production. *PLoS ONE*, 10(6), 1–16
- [8] Egli, D. B. (1999). Variation in leaf starch and sink limitations during seed filling in soybean. – *Crop Science* 39(5): 743–745.
- [9] Ghassemi-Golezani, K., Zafarani-Moattar, P., Raey, Y., Mohammadi, A. (2010): Response of pinto bean cultivars to water deficit at reproductive stages. – *Journal of Food, Agriculture and Environment* 8(2): 801–804.
- [10] Gomez, A. G., Gomez, K. A. (1984): *Statistical procedures for agricultural research* (Second ed.). New York, Chichester, Brisbane, Toronto, Singapore: John Wiley & Sons, Inc.
- [11] Hatfield, J. L., Boote, K. J., Kimball, B. A., Ziska, L. H., Izaurralde, R. C., Ort, D., A. M. Thomson, A. M., Wolfe, D. (2011): Climate impacts on agriculture: implications for crop production. – *Agronomy Journal* 103(2): 351–370.
- [12] Kobraei, S., Etminan, A., Mohammadi, R., Kobraee, S. (2011): Effects of drought stress on yield and yield components of soybean. – *Annal of Biological Research* 2(5): 504–509.
- [13] Li, X., Schmid, B., Wang, F., Paine, C. E. T. (2016): Net assimilation rate determines the growth rates of 14 species of subtropical forest trees. *PLoS ONE* 11(3): 1–13.
- [14] López-Bellido, F. J., López-Bellido, R. J., Khalil, S. K., López-Bellido, L. (2008): Effect of planting date on winter Kabuli chickpea growth and yield under rainfed Mediterranean conditions. – *Agronomy Journal* 100(4): 957–964.
- [15] Luo, H. H., Zhang, Y. L., Zhang, W. F. (2016): Effects of water stress and rewatering on

- photosynthesis, root activity, and yield of cotton with drip irrigation under mulch. – *Photosynthetica* 54(1): 65–73.
- [16] Maleki, A., Naderi, A., Naseri, R., Fathi, A., Bahamin, S., Maleki, R. (2013): Physiological performance of soybean cultivars under drought stress. – *Bulletin of Environment, Pharmacology and Life Sciences* 2: 38–44.
- [17] Marchese, J. A., Ferreira, J. F. S., Rehder, V. L. G., Rodrigues, O. (2010): Water deficit effect on the accumulation of biomass and artemisinin in annual wormwood (*Artemisia annua* L., Asteraceae). – *Brazilian Journal of Plant Physiology* 22(1): 1–9.
- [18] Nleya, T., & Sexton, P. (2019). Soybean Growth Stages. In Soybean Extension and Research Program. pp. 1-1. https://crops.extension.iastate.edu/soybean/production_growthstages.html
- [19] Ozalkan, C., Sepetoglu, H. T., Daur, I., Sen, O. F. (2010): Relationship between some plant growth parameters and grain yield of chickpea (*Cinger arietinum* L .) during different growth stages. – *Turkish Journal of Field Crops* 15(1): 79–83.
- [20] Patriyawaty, N. R., Anggara, G. W. (2020): Pertumbuhan dan hasil genotipe kedelai (*Glycine max* (L.) Merrill) pada tiga tingkat cekaman kekeringan. – *Agromix* 11(2): 151–165. (in Indonesian)
- [21] Sacita, A. S., June, T., Impron. (2018): Soybean adaptation to water stress on vegetative and generative phases. – *Agrotech Journal ATJ* 3(2): 42–52.
- [22] Samarah, N. H., Alqudah, A. M., Amayreh, J. A., Mcandrews, G. M. (2009): The effect of late-terminal drought stress on yield components of four barley cultivars. – *J.Agronomy & Crop Science* 195: 427–441.
- [23] Sridevi, V., Chellamuthu, V. (2015): Growth analysis and yield of rice as affected by different systems of rice intensification (SRI) practices. – *International Journal of Research in Applied, Natural and Social Sciences* 3(4): 29–36.
- [24] Talbi, S., Rojas, J. A., Sahrawy, M., Rodríguez-Serrano, M., Cárdenas, K. E., Debouba, M., Sandalio, L. M. (2020): Effect of drought on growth, photosynthesis and total antioxidant capacity of the Saharan plant *Oudeneya africana*. – *Environmental and Experimental Botany* 176: 104099.
- [25] Thu, N. B. A., Nguyen, Q. T., Hoang, X. L. T., Thao, N. P., Tran, L. S. P. (2014): Evaluation of drought tolerance of the Vietnamese soybean cultivars provides potential resources for soybean production and genetic engineering. – *BioMed Research International* 2014: 1-9.
- [26] Zulfiqar, F., Younis, A., Riaz, A., Mansoor, F., Hameed, M., Akram, N. A., Abideen, Z. (2020): Morpho-anatomical adaptations of two tagetes erecta l. Cultivars with contrasting response to drought stress. – *Pakistan J*

COVER LETTER : 19 Februari 2022

The screenshot shows a Yahoo! Mail interface. The email subject is "Manuscript submission" and it is from Achmad Fatchul Aziez to aeerjournal@gmail.com, dated Saturday, February 19, 2022, at 10:32 PM. The email body contains the following text:

COVER LETTER
To Applied Ecology and Environmental Research

Dear Editor,

I would like to send an original article entitled "The Effect of Drought Stress on the Growth and Yield of Soybean" for Applied Ecology and Environmental Research. I confirm that this work is genuine and has not been published elsewhere, nor is it considered for publication elsewhere. We believe and hope that this manuscript is worthy of publication in Applied Ecology and Environmental Research. We are interested in publishing articles in this journal because it has an excellent reputation, so it is a matter of pride if published in Applied Ecology and Environmental Research. Here I attach the manuscript and open access license.

Thank you
Best regards,

The interface also shows a sidebar with folders like Inbox (431), Unread, Starred, Drafts (30), Sent, Archive, Spam, Trash, and Less. A search bar is at the top with the text "Find messages, documents, photos or people".

RESUBMIT MANUSCRIPT: 24 Februari 2022

The screenshot shows a Yahoo! Mail interface. The email subject is "Manuscript (revision)" and it is from Applied Ecology to Achmad Fatchul Aziez, dated Thursday, February 24, 2022, at 5:24 PM. The email body contains the following text:

Dear Author,

Thank you for your resubmission of MS ref. 13439.

Best regards,

Technical Editors
Applied Ecology and Environmental Research
Open Access International Scientific Journal
<http://www.aloki.hu>

Achmad Fatchul Aziez <achmad.aziez@yahoo.com> ezt írta (időpont: 2022. febr. 20., V. 0:26):
> Show original message

The interface also shows a sidebar with folders like Inbox (431), Unread, Starred, Drafts (30), Sent, Archive, Spam, Trash, and Less. A search bar is at the top with the text "Find messages, documents, photos or people".

**THE EFFECT OF DROUGHT STRESS ON THE GROWTH AND YIELD OF SOYBEAN
(*Glycine max* L.)**

AEER_13439
(Received; accepted)

Abstract. drought stress affects the growth and yield of soybean. stunted growth will have an impact on yield. this study aims to determine the effect of drought stress on the growth characteristics and grain yield of soybean. this research uses a randomized complete block design (RCBD) and three replications. the first factor was soil moisture content consisting of three levels, i.e., 100%, 75%, 50%, and 25% field capacity. the second factor was the growth stage consisting of three kinds, i.e., the vegetative active, flowering, and seed filling stages. the results showed that soil moisture content below 75% field capacity reduced the leaf area index (LAI), leaf area duration (LAD), specific leaf area (SLA), net assimilation rate (NAR), crop growth rate (CGR), the seed weight per 100 seeds, and the weight of the seeds per plant. in seed filling stage is more sensitive to water shortages than the vegetative or flowering stages. at all stages of growth, a higher drought level equals a higher decrease in the soybean growth and yield. for future research, we suggest that soybean planting utilize 100% field capacity.

Keywords: field capacity, grain, growth analysis, growth phase, soil moisture

Introduction

Drought stress has significantly reduced agricultural productivity worldwide, including in soybean (*Glycine max* L.) seeds (Buezo et al. 2019). In Indonesia, soybeans are often grown as an intercropping plant after rice and are widely cultivated in times of drought. Soybean production during the dry season is constrained by limited water availability. Therefore, some or all stages of plant development are affected by drought.

Along with the increase in air temperature caused by global warming, drought also harms soybean production, decreasing seed yields (Daryanto et al., 2015). Ahmed et al. (2010) stated that the lack of water increased the canopy's root ratio to increase water utilization. Thu et al. (2014) found that roots were distributed to the topsoil zone if sufficient water was available. If not, roots would grow and develop in deeper soil.

In general, drought stress affected the vegetative and generative phases of plants and resulted in a yield decrease. The reproduction phase is sensitive to drought stress as it directly affects the flowering and pod filling stages (Hatfield et al., 2011). Ghassemi-Golezani et al. (2010) found that drought stress decreased the number of flowers and filled pods in the reproductive phase. The plant can not effectively distribute carbohydrates from leaves to pods, reducing the amount and size of produced seeds.

Alqudah et al. (2011) and Ozalkan et al. (2010) stated that the LAI, NAR, and CGR continued to increase until the pod filling stage. Over its entire vegetation period, chickpeas had a reduced LAD, specifically in their initial pod arrangement while their biomass increases. LAD positively correlated with the biomass and yield of chickpeas in Southern Spain (López-Bellido et al., 2008). In several varieties, Ozalkan et al. (2010) found that CGR was greater at the pod filling stage compared to earlier stages. Furthermore, Ozalkan et al. (2010) stated that the growth

process, namely CGR, RGR, and NAR, directly affected economic gains, as seen in greater grain yields. In plants, researchers had identified development parameters such as optimum LAI and CGR during the flowering stage as the main determinants of yield (Baloch et al., 2006). The vegetative and generative growth stages of soybean consisted of emergence, first trifoliolate, second trifoliolate, third to fifth trifoliolate, sixth trifoliolate, beginning bloom, full bloom, beginning pod, full pod, beginning seed, full seed, beginning maturity, and full maturity (Nleya and Sexton, 2019).

Maleki et al. (2013) examined soybean plants undergoing drought stress treatment at various stages of growth in several varieties. The results showed that drought stress and variant significantly affected plant height, fertile pods, harvest index, oil, and protein percentages. Under drought stress, the seed filling and flowering stages showed the lowest production with a yield of 2,682 kg.ha⁻¹ and 2,918 kg.ha⁻¹, respectively. Luo et al. (2016) examined cotton plants in four growth phases given light and moderate water stress. The results showed that the water deficit significantly reduced leaf water potential, net photosynthetic rate, and stomatal conductance in cotton. In this study, there was no clear mention of moisture levels for mild or moderate stress.

Marchese et al. (2010) examined *Artemisia annua* L. plants with five water deficit treatments, namely irrigated, 14, 38, 62, 86 hours, and without irrigation. The results showed that water deficit limits plant growth but can trigger the accumulation of secondary metabolites. Water deficits of 38 and 62 hours increased leaf artemisinin content. However, only the 38-hour treatment caused a significant increase in leaf and plant artemisinin without negatively affecting plant biomass production. In a greenhouse study, Samarah et al. (2009) compared four wheat varieties with a soil moisture content of 75%, 50%, and 25% field capacity. This research did not attempt to determine the optimal moisture content for growth; it compared variants and their relation with drought and yield. Zulfiqar et al. (2020) studied two varieties of marigolds under the stress of 60% and 40% field capacity. The results showed that leaf thickness decreased at 40% field capacity and the Inca variety was more resistant than the Bonanza variety to water stress.

Sacita et al. (2018) researched two varieties in their vegetative and generative phases, with irrigation intervals of 2.5 and 10 days. The results showed that water stress in the vegetative stage had no significant effect on soybean production. Soybean plants adapt to water stress by reducing the leaf number, leaf area, and stomata openings and responding to a motion by folding the leaves.

Many previous studies examined the effect of drought stress on plant morphological characteristics and only a few examined the effect of drought stress on plant physiological characteristics, especially soybeans, and this physiological observation was only observed at harvest time. Research that has not been carried out is to examine drought stress on physiological characters and soybean yields at various growth stages. There has been no attempt to examine the effects of drought stress at various stages of growth on the growth characteristics and yield of soybean. This research will attempt to determine the stage of soybean growth most affected by water stress which can impact soybean yield. Based on the description above, this research aims to determine the effect of drought stress on the growth characteristics and yield of soybean.

Materials and Methods

Study area

The team conducted the research in a plastic house in Demangan, Sambu, Boyolali, Central Java, Indonesia, from August to November 2020 with alfisol soil. The Department of Food Crops Agriculture, Grobogan, Central Java, Indonesia provides soybean seeds with a drought-resistant variant of Grobogan. A geographical position was between 110° 22'-110° 50' east longitude and between 7°7'-7°36' south latitude with a height of 184 m above sea level (ASL). The average rainfall and temperature were 139 mm month⁻¹ and 26-32°C, respectively.

Experimental design

This research was arranged in a randomized completely block design (RCBD) with two factors and three replications. The first factor was soil moisture content consisting of four levels, i.e., 100%, 75%, 50%, and 25% field capacity. The second factor was the growth stage, which consisting of three kinds, i.e., the active vegetative, flowering, and pod filling stages. In this study, there were 12 treatment combinations. Each treatment combination was three times replications, and each replication consisting of four plant samples. Overall, the study required 144 polybags.

Research procedures

Before the research, the team conducted a chemical analysis of the soil used for the research substrate. The results showed an H₂O pH of 6.38 (slightly sour), C concentration of 3.60% (very high), organic matter concentration of 6.22% (very high), total N concentration of 0.15% (low), available P of 8.10 ppm (very high), available K of 0.79 me/100 g (high) and CEC value of 26.12 me/100 g (high).

The media used was 10 kg of alfisol soil and manure at a ratio of 1:1. After being prepared and mixed, the media filled a 35 × 35 cm polybag as a medium for soybean seeds. NPK Phonska and SP-36 fertilizers at a dose of 100 and 75 kg ha⁻¹, respectively, were applied at planting time and five weeks after planting.

The planting utilized a depth of 3 cm, with each polybag containing three soybean seeds. The selection process took 14 days selected one plant. Thinning was conducted 1 week after planting (WAP), leaving one plant per polybag. During the research, no weeds, pests, or diseases caused significant problems. Therefore, the team did not carry out control measures. According to the treatment, water application must reach a soil moisture content of 100%, 75%, 50%, and 25% field capacity by accounting for the growth stages, namely the active vegetative, flowering, and pod filling stages. Harvesting was conducted 90 days after planting (DAP).

Measurement

The parameters observed were the leaf area index (LAI), leaf area duration (LAD), specific leaf area (SLA), net assimilation rate (NAR), crop growth rate (CGR), and the weight of the seeds per plant. The data observation was conducted in 4, 6, 8, and 10 WAP. LAI was calculated from the ratio between the total leaf surface area per unit ground area. LAI was determined by the intensity of radiation intercepted divided planting spacing. LAD is the time a leaf could last on the plant. LAD was calculated from leaf area (cm²) divided by time (week)

NAR is the ability of plants to produce dry materials that assimilate each unit of leaf area at each unit of time, which is stated in Eq. 1.

$$\text{NAR} = \frac{W_2 - W_1}{t_2 - t_1} \times \frac{\ln LA_2 - \ln LA_1}{LA_2 - LA_1}, \text{ (in g.cm}^{-2}\text{.weeks}^{-1}\text{)} \quad (\text{Eq. 1})$$

CGR is the ability of plants to produce dry materials that assimilate each unit of land area at each unit of time, which is stated in Eq. 2.

$$\text{CGR} = \frac{1}{G} \times \frac{W_2 - W_1}{t_2 - t_1}, \text{ (in g.m}^{-2}\text{.weeks}^{-1}\text{)} \quad (\text{Eq. 2})$$

Description: W1 = total dry weight per plant at the time of t1. W2= Total dry weight per plant at the time of t2. LA1= Total leaf area per plant at the beginning. LA2 = Total leaf area per plant at the time of t2. G = the area of land overgrown with plants. t1 = harvest time in the beginning. t2 = harvest time in the end.

Statistical analysis

Observational data were analyzed using analysis of variance (ANOVA) with the SAS 9.1 program. If the treatment had a significant effect, then to know the difference between treatments was done using Duncan's new multiple range tests (DMRT) at 5% significance level (Gomez and Gomez 1984).

Results

Analysis of variance

Based on the analysis of variance, there is an interaction between the level of drought and the growth rate on the parameters of LAI, LAD, NAR, SLA, CGR, at 4-6, 6-8, 8-10, and 10-12 WAP, the weight of 100 seeds and seeds per plant at harvest (Table 1.)

Table 1: Analysis of variance of all parameters

Parameter	Time observation (WAP)	Drought stress level (S)	Growth Stage (G)	S x G
Leaf area index (LAI)	4-6	4.94**	0.67 ns	3.31 **
	6-8	9.86**	0.04 ns	3.18 **
	8-10	3.74*	0.30 ns	2.81 *
	10-12	9.33**	0.73 ns	4.89 **
Leaf area duration (LAD)	4-6	6.42 **	1.47 ns	3.90 **
	6-8	9.19 **	0.04 ns	2.46 *
	8-10	3.99 *	0.06 ns	3.05 *
	10-12	13.68 **	5.77 **	13.15 **
Specific Leaf Area (SLA)	4-6	3.83 *	0.19 ns	3.28 **
	6-8	3.34 *	0.19 ns	2.62 *
	8-10	2.58 ns	0.43 ns	3.08 *
	10-12	8.67 **	1.57 ns	5.48 **
Net assimilation rate (NAR)	4-6	3.02 *	0.14 ns	2.42 *
	6-8	4.27 *	0.13 ns	2.73 *
	8-10	2.77 *	0.08 ns	2.41 *
	10-12	5.46 **	0.22 ns	3.76 **
Crop Growth Rate (CGR)	4-6	5.15 **	0.73 ns	2.80 *
	6-8	4.81 **	0.29 ns	2.25 *

	8-10	5.05 **	0.29 ns	3.40 **
	10-12	2.39 ns	0.20 ns	2.24 *
Weight of 100 seeds	12	15.42 **	33.73 **	49.36 **
Seeds per plant	<u>12</u>	25.09 **	5.71 **	8.95 **

Note: ** = Significance at 1% significant levels, * = Significance at 5% significant levels, and ns = Non significant at 5%. WAP = week after planting

Leaf area index

The ANOVA showed a significant interaction between soil moisture and growth rate on LAI at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average LAI in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 2.

Table 2. LAI at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10 -12 WAP

Soil moisture (% field capacity)	Growth stage	LAI			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active vegetative	0.75 ab	1.05 ac	1.20. b	0.88 ab
	Flowering	0.85 a	1.21 ab	1.24 ab	0.90 ab
	Seed filling	0.69 ab	1.34 a	1.34. a	0.95 a
75	Active vegetative	0.73 ab	1.04 a-c	1.26 ab	0.87 ab
	Flowering	0.70 ab	0.99 b-d	1.22 ab	0.86 ab
	Seed filling	0.70 ab	1.02 a-c	1.26 ab	0.90 ab
50	Active vegetative	0.59 b	0.87 b-d	1.22 ab	0.86 ab
	Flowering	0.61 b	0.86 b-d	1.20 b	0.83 bc
	Seed filling	0.72 ab	0.83 cd	1.15 bc	0.72 d
25	Active vegetative	0.63 ab	0.84 cd	1.23 ab	0.81 b-d
	Flowering	0.34 c	0.82 cd	1.15 bc	0.74 cd
	Seed filling	0.63 ab	0.67 d	1.06 c	0.71 d
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. LAI = leaf area index WAP = week after planting

Table 2 shows that at 4-6, 6-8, 8-10, and 10-12 WAP, the highest LAI occurred at a soil moisture content of 100% field capacity during the seed filling stage. The lowest LAI occurred at

a soil moisture content of 25% field capacity during the seed filling the stage at 6-8, 8-10, and 10-12 WAP.

Leaf area duration

The ANOVA on LAD showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average LAD in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 3.

Table 3. LAD at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10-12 WAP

Soil moisture (% field capacity)	Growth stage	LAD (cm ² week ⁻¹)			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active	959 ab	1318 a-c	1258 b-d	1220 ab
	vegetative				
	Flowering	1021 a	1505 ab	1271 a-d	1140 bc
75	Seed filling	926 ab	1596 a	1362 a	1268 a
	Active	944 ab	1303 a-c	1317 ab	1118 b-d
	vegetative				
50	Flowering	895 ab	1249 a-c	1260 b-d	1239 ab
	Seed filling	913 ab	1281 a-c	1305 ab	934 ef
	Active	833 ab	1079 bc	1256 b-d	1129 b-d
25	vegetative				
	Flowering	794 b	1013 c	1286 a-c	1037 c-e
	Seed filling	824 ab	1032 c	1190 cd	915 ef
25	Active	814 ab	1005 c	1221 b-d	1008 de
	vegetative				
	Flowering	533 c	1007 c	1244 b-d	929 ef
	Seed filling	865 ab	898 c	1171 d	845 f
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. LAD = leaf area duration, and WAP = week after planting

Table 3 shows that LAD had the same pattern as LAI. The highest value occurred at a soil moisture content of 100% field capacity during the seed filling stage, while the lowest occurred at a soil moisture content of 25% field capacity during the seed filling stage at 6-8, 8-10, and 10-12 WAP.

Specific leaf area

The ANOVA on SLA showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average SLA in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 4

Table 4. SLA at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10 -12 WAP

Soil moisture (% field capacity)	Growth stage	SLA (cm ² .g ⁻¹)			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active vegetative	287.33 ab	230.00 ab	246.67 ab	225 a-d
	Flowering	321.67 a	237.00 ab	241.67 b	254 ab
	Seed filling	298.33 ab	270.00 a	313.67 a	278 a
75	Active vegetative	275.00 ab	232.33 ab	272.00 ab	245 a-c
	Flowering	291.67 ab	225.67 ab	241.33 b	169 d
	Seed filling	283.33 ab	230.67 ab	272.33 ab	220 a-d
50	Active vegetative	282.33 ab	236.00 ab	268.00 ab	224 a-d
	Flowering	288.67 ab	219.67 b	231.33 b	192 b-d
	Seed filling	280.33 ab	225.67 ab	249.67 ab	162 de
25	Active vegetative	287.67 ab	224.33 ab	241.00 b	184 cd
	Flowering	199.00 c	221.67 b	246.67 ab	167 d
	Seed filling	264.33 b	169.00 c	156.33 c	102 e
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. SLA = specific leaf area WAP = week after planting

Table 4 shows that the highest specific leaf area during 4-6, 6-8, 8-10, and 10-12 WAP were at a soil moisture content of 100% field capacity during the seed filling stage. Meanwhile, the lowest SLA occurred at a soil moisture content of 25% field capacity during the seed filling the stage at 6-8, 8-10, and 10-12 WAP. Drought stress is most detrimental to soybean plants during generative growth, especially during the seed filling stage

Net assimilation rate

The ANOVA on NAR showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average NAR in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 5.

Table 5. NAR at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10-12 WAP

Soil moisture (% field capacity)	Growth stage	NAR (x 10 ⁻⁵ g.cm ⁻² .week ⁻¹)			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active vegetative	332.33 bc	306.67 ab	168.33 ab	24.47 c-e
	Flowering	560.99 a	243.67 a-d	151.00 a-c	317.26 a-d
	Seed filling	502.00 ab	372.00 a	208.33 a	219.47 e

75	Active	451.43 ab	277.00 a-c	144.67 bc	277.15 b-e
	vegetative				
	Flowering	464.67 ab	283.67 a-c	192.33 ab	228.48 de
50	Seed filling	480.43 ab	304.00 ab	160.33 a-c	229.36 de
	Active	402.33 ab	254.67 a-d	164.33 ab	286.29 b-e
	vegetative				
25	Flowering	445.67 ab	261.33 a-d	135.00 bc	298.46 b-e
	Seed filling	384.67 a-c	373.33 cd	141.33 bc	351.27 ab
	Active	417.67 ab	189.00 b-d	139.67 bc	320.32 a-c
	vegetative				
	Flowering	194.33 c	259.67 a-d	155.00 a-c	301.68 b-e
	Seed filling	340.00 bc	137.67 d	101.00 c	387.76 a
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. NAR = net assimilation rate WAP = week after planting

Table 5 shows that during 4-6 WAP, the NAR value was highest at a soil moisture content of 100% field capacity during the flowering stage, while the lowest was at a soil moisture content of 25% field capacity during the flowering stage. Conditions during 6-8 and 8-10 WAP had the same pattern as previous observations. Conditions during 10-12 WAP contradict previous results, as the NAR value was highest at a soil moisture content of 25% field capacity during the seed filling stage, while the lowest was at a soil moisture content of 100% field capacity during the seed filling stage.

Crop growth rate

The ANOVA on CGR showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average CGR in ages of 4-6, 6-8, 8-10, and 10-12 WAP are shown in Table 6.

Table 6. CGR at various levels of drought and growth stages at 4-6, 6-8, 8-10, and 10-12 WAP

Soil moisture (% field capacity)	Growth stage	CGR ($\times 10^{-5}$ mg.cm ⁻² .week ⁻¹)			
		4-6 WAP	6-8 WAP	8-10 WAP	10-12 WAP
100	Active	272.33 ab	271.00 bc	193.67 a-c	330.85 bc
	vegetative				
	Flowering	318.00 a	300.00 a-c	185.67 a-d	252.36bc
	Seed filling	267.67 ab	418.00 a	234.67 a	188.62 c
75	Active	274.33 ab	321.67 ab	186.00 a-d	233.82 bc
	vegetative				
	Flowering	246.33 a-c	303.67 a-c	227.33 ab	251.48 bc
50	Seed filling	252.33 a-c	311.67 a-c	186.33 a-d	232.69 bc
	Active	240.33 bc	239.67 bc	200.00 a-c	270.26 ab
	vegetative				

	vegetative				
	Flowering	189.33 c	238.67 bc	182.67 b-d	246.47 bc
	Seed filling	276.33 ab	242.00 bc	154.00 cd	272.62 ab
25	Active	220.67 bc	255.00 bc	168.00 cd	256.38 bc
	vegetative				
	Flowering	187.67 c	224.33 bc	154.67 cd	236.78 bc
	Seed filling	223.00 bc	182.00 c	141.00 d	334.32 a
Interaction treatments		(+)	(+)	(+)	(+)

Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels. CGR = Crop Growth Rate and WAP = week after planting

Table 6 shows that 4-6, 6-8, and 8-10 WAP showed the same pattern, namely having the highest Crop Growth Rate (CGR) at 100% soil moisture content during the seed filling stage while having the lowest at a soil moisture content of 25% during the seed filling stage. However, conditions during 10-12 WAP had the opposite pattern to previous observations. The CGR value was highest at a soil moisture content of 25% field capacity during the seed filling stage, while the lowest was at a soil moisture content of 100% field capacity during the seed filling stage. NAR showed the same pattern, meaning that CGR related to NAR.

Seeds weight

The ANOVA on seed weight per 100 seeds and per plant showed a significant interaction between soil moisture and growth rate at the ages of 4-6, 6-8, 8-10, and 10-12 WAP. The result of DMRT at 5% significant levels on the average seed weight per 100 seeds and plants is shown in Table 7.

Table 7. Weight of 100 seeds (g) and weight of seeds per plant (g) at various levels of drought and growth stages

Soil moisture (% field capacity)	Growth stage	Seed weight	
		g 100 seeds ⁻¹	g plant ⁻¹
100	Active vegetative	14.013 a	4.285 a
	Flowering	13.580 a	3.594 ab
	Seed filling	13.187 a	3.837 ab
75	Active vegetative	13.183 a	.315 b
	Flowering	13.793 a	3.565 ab
	Seed filling	10.353 c	2.994 bc
50	Active vegetative	11.787 b	3.303 b
	Flowering	13.607 a	2.941 bc
	Seed filling	7.293 d	2.231 cd
25	Active vegetative	11.477 bc	2.174 cd
	Flowering	11.890 b	2.332 c
	Seed filling	5.307 c	1.441 d

Interaction treatments	(+)	(+)
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Note: The numbers followed by the same characters in the same column indicate no significant difference based on DMRT at 5% significant levels.

Table 7 shows that the highest seed weight per plant occurred at a soil moisture content of 100% field capacity in the active vegetative stage, while the lowest was at a soil moisture content of 25% field capacity in the seed filling stage. This pattern was identical to the pattern of the weight of 100 seeds.

Discussion

Regardless of drought stress, the LAI value increased from 4-6 to 6-8 and from 6-8 to 8-10 WAP. However, from 8-10 to 10-12 WAP, the LAI value decreased. This decrease was due to the harvest age, in which the leaves begin to experience senescence. In this research, 8-10 WAP showed the highest LAI value. However, Özalkan et al. (2010) found the highest LAI and LAD values during the linear vegetative growth stage.

The four observation periods showed that rather than the growth stage, drought stress determines the value of LAI. Drought stress was inversely proportional to the LAI value. One of the functions of water was to support the photosynthetic process. With decreased photosynthesis, the size of the leaves will also decrease. The disruption in cell division and enlargement in drought stress conditions was due to loss of turgor and decreased photosynthesis and energy supply caused a decrease in leaf area (Talbi et al. 2020).

Hatfield et al. (2011), stated that drought stress affected the growth of the vegetative and generative stages of plants, decreasing crop yields. However, the reproductive stage was highly sensitive to drought stress as it directly affected the flowering and pod filling stages. The linear vegetative growth stage showed the highest LAI and LAD values (Özalkan et al. 2010). The NAR represents the ability of plants to produce dry matter (Da-yong et al., 2012). The NAR value showed a positive correlation with RGR (Li et al., 2016). Therefore, NAR can act as the main determinant of the RGR value. In general, SLA increases from initial growth to 10 WAP, after which it decreased as leaves begin to experience senescence. Plants with severe drought did not experience an increase in SLA, especially in the vegetative or seed filling stages. One of the functions of water is to accommodate photosynthesis. With low photosynthesis activity, leaf size will not increase at its usual rate.

Regardless of drought stress, the CGR value increased from 4-6 WAP to 6-8 WAP and decreased from 6-8 to 8-10 WAP. The plants have entered the seed filling stage from 6-8 to 8-10 WAP, decreasing dry weight. According to Anjum et al. (2014), CGR will be continued to increase until the middle growth stage and decrease towards maturity.

During rice plant growth, NAR and RGR generally show an increase (height) at the beginning of the growth phase, then decrease rapidly with plant age (Sridevi and Chellamuthu 2015). At 40-50 days after planting, NAR had a weak positive correlation with grain yield. The flowering stage showed the highest NAR and CGR scores (Ozalkan et al., 2010). Ozalkan et al. (2010) stated that there was a significant correlation among most of the growth parameters during all growth stages.

One of the functions of water is to translocate the assimilation from the leaf (source organ) to the seed (sink organ). A lack of water will hamper the seed filling process. Drought stress

affects seed production and quality (Alqudah et al., 2011). Ghassemi-Golezani et al. (2010) stated that drought stress experienced during the reproductive phase decreases flowers and filled pods. This stress inhibited the distribution of carbohydrates from the leaf to the pod, resulting in a decrease in the number and size of seeds (Alqudah et al., 2011).

A considerable lack of water will reduce the quality and quantity of soybean production. Hatfield et al. (2011) stated that drought stress affected the growth of plants during the vegetative and generative stages, which ultimately resulted in a decrease in crop yields. The occurrence of water shortages and high temperatures at the beginning of the flowering to the ripening stage accelerated the pod filling period and reduced yield weight (Kobraei et al., 2011).

Plant morpho-physiological characteristics, such as leaf thickness and plant growth rates affected productivity, considering that these characteristics affected photosynthesis speed. For long periods, a high seed filling rate will produce a high seed weight as long as the seed as a sink can accommodate a high assimilation rate. Conversely, a large enough sink with a low assimilation rate can result in a seed void. Source limitations often occur during the seed filling stage but sink limitations can occur even in non-stress conditions (Egli 1999). Production had a significant positive correlation with the net photosynthetic rate (NAR) (Da-yong et al., 2012). Drought stress reduced the yield of soybean. A soil moisture content of 80 and 60% field capacity reduced the yield of soybean genotypes by 15.7% and 23.4%, respectively (Patriyawaty and Anggara 2020). Daryanto et al. (2015) stated that yield reduction was generally higher in legumes experiencing drought during their reproductive stage than during their vegetative stage. Sridevi and Chellamuthu (2015) found that higher grain yields reflected satisfactory dry matter production, LAI, LAD, CGR, NAR, and RGR values.

Conclusion

In conclusion, our study found that soil moisture content at below 75% field capacity reduced the LAI, LAD, SLA, NAR, CGR, the seed weight per 100 seeds, and seed weight per plant. In seed filling stage is more sensitive to water shortages than the vegetative or flowering stages. At all stages of growth, a higher drought level equals a higher decrease in soybean growth and yield. For future research, we suggest that soybean planting utilize 100% field capacity.

Acknowledgements

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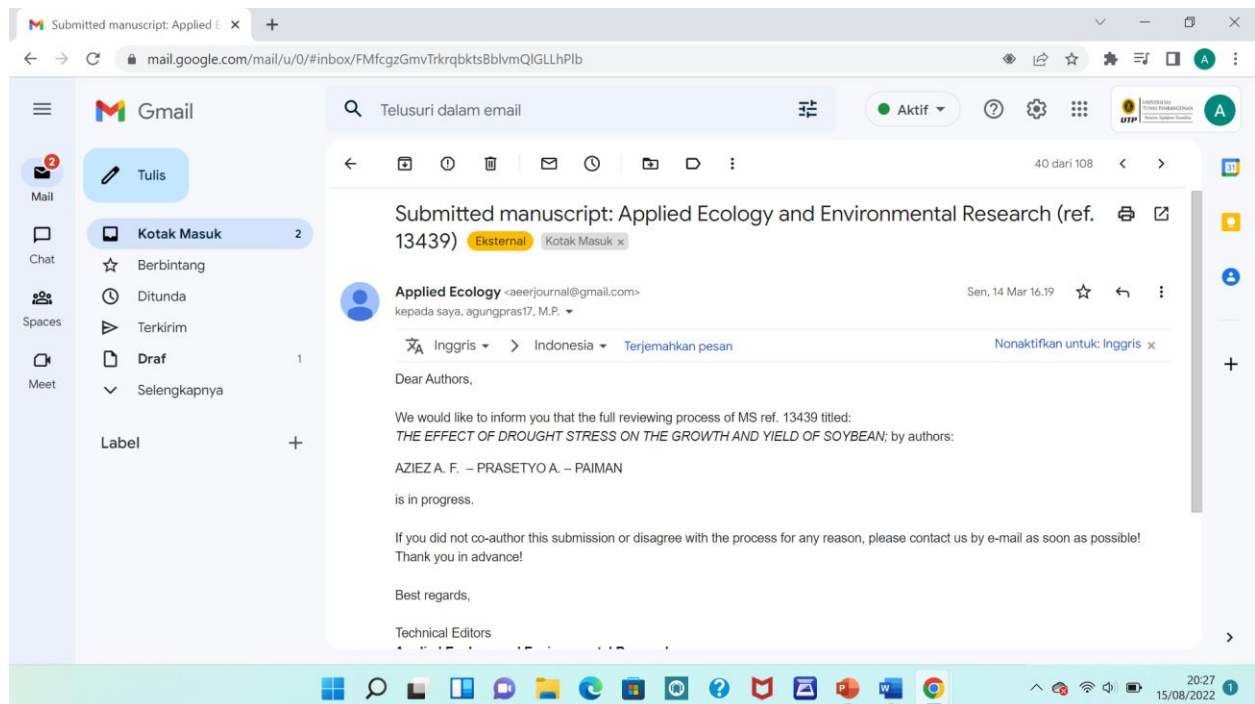
References

- [1] Ahmed, S. U., Senge, M., Ito, K., Adomako, J. T. (2010): The effect of deficit irrigation on root/shoot ratio, water use efficiency and yield efficiency of soybean. – *Journal of Rainwater Catchment Systems* 15(2): 39–45
- [2] Alqudah, A. M., Samarah, N. H., Mullen, R. E. (2011): Drought stress effect on crop pollination, seed set, yield, and quality. In *Alternative Farming Systems, Biotechnology, Drought Stress, and Ecological Fertilisation, Sustainable Agriculture Reviews* 6: 193–213.
- [3] Anjum, S. A., Ashraf, U., Tanveer, M. (2014): Morphological and phenological attributes of maize affected by different tillage practices and varied sowing methods. *American Journal of Plant Sciences* 5: 1657-1664.

- [4] Baloch, M. S., Awan, I. U., Hassan, G. (2006): Growth and yield of rice as affected by transplanting dates and seedlings per hill under high temperature of Dera Ismail Khan, Pakistan. – *Journal of Zhejiang University* 7(7): 572–579.
- [5] Buezo, J., Sanz-Saez, Á., Moran, J. F., Soba, D., Aranjuelo, I., Esteban, R. (2019): Drought tolerance response of high-yielding soybean varieties to mild drought: physiological and photochemical adjustments. – *Physiologia Plantarum* 166(1): 88–104.
- [6] Da-yong, L., Zhi-an, Z., Dian-jun, Z., Li-yan, J., Yuan-li, W. (2012): Comparison of net photosynthetic rate in leaves of soybean with different yield levels. – *Journal of Northeast Agricultural University* 19(3): 14–19.
- [7] Daryanto, S., Wang, L., Jacinthe, P. A. (2015): Global synthesis of drought effects on food legume production. *PLoS ONE*, 10(6), 1–16
- [8] Egli, D. B. (1999). Variation in leaf starch and sink limitations during seed filling in soybean. – *Crop Science* 39(5): 743–745.
- [9] Ghassemi-Golezani, K., Zafarani-Moattar, P., Raey, Y., Mohammadi, A. (2010): Response of pinto bean cultivars to water deficit at reproductive stages. – *Journal of Food, Agriculture and Environment* 8(2): 801–804.
- [10] Gomez, A. G., Gomez, K. A. (1984): *Statistical procedures for agricultural research* (Second ed.). New York, Chichester, Brisbane, Toronto, Singapore: John Wiley & Sons, Inc.
- [11] Hatfield, J. L., Boote, K. J., Kimball, B. A., Ziska, L. H., Izaurralde, R. C., Ort, D., A. M. Thomson, A. M., Wolfe, D. (2011): Climate impacts on agriculture: implications for crop production. – *Agronomy Journal* 103(2): 351–370.
- [12] Kobraei, S., Etminan, A., Mohammadi, R., Kobraee, S. (2011): Effects of drought stress on yield and yield components of soybean. – *Annal of Biological Research* 2(5): 504–509.
- [13] Li, X., Schmid, B., Wang, F., Paine, C. E. T. (2016): Net assimilation rate determines the growth rates of 14 species of subtropical forest trees. *PLoS ONE* 11(3): 1–13.
- [14] López-Bellido, F. J., López-Bellido, R. J., Khalil, S. K., López-Bellido, L. (2008): Effect of planting date on winter Kabuli chickpea growth and yield under rainfed Mediterranean conditions. – *Agronomy Journal* 100(4): 957–964.
- [15] Luo, H. H., Zhang, Y. L., Zhang, W. F. (2016): Effects of water stress and rewatering on photosynthesis, root activity, and yield of cotton with drip irrigation under mulch. – *Photosynthetica* 54(1): 65–73.
- [16] Maleki, A., Naderi, A., Naseri, R., Fathi, A., Bahamin, S., Maleki, R. (2013): Physiological performance of soybean cultivars under drought stress. – *Bulletin of Environment, Pharmacology and Life Sciences* 2: 38–44.
- [17] Marchese, J. A., Ferreira, J. F. S., Rehder, V. L. G., Rodrigues, O. (2010): Water deficit effect on the accumulation of biomass and artemisinin in annual wormwood (*Artemisia annua* L., Asteraceae). – *Brazilian Journal of Plant Physiology* 22(1): 1–9.
- [18] Nleya, T., & Sexton, P. (2019). Soybean Growth Stages. In *Soybean Extension and Research Program*. pp. 1-1. https://crops.extension.iastate.edu/soybean/production_growthstages.html
- [19] Ozalkan, C., Sepetoglu, H. T., Daur, I., Sen, O. F. (2010): Relationship between some plant growth parameters and grain yield of chickpea (*Cinger arietinum* L.) during different growth stages. – *Turkish Journal of Field Crops* 15(1): 79–83.
- [20] Patriyawaty, N. R., Anggara, G. W. (2020): Pertumbuhan dan hasil genotipe kedelai (*Glycine max* (L.) Merrill) pada tiga tingkat cekaman kekeringan. – *Agromix* 11(2): 151–165. (in Indonesian)
- [21] Sacita, A. S., June, T., Impron. (2018): Soybean adaptation to water stress on vegetative and

- generative phases. – *Agrotech Journal ATJ* 3(2): 42–52.
- [22] Samarah, N. H., Alqudah, A. M., Amayreh, J. A., Mcandrews, G. M. (2009): The effect of late-terminal drought stress on yield components of four barley cultivars. – *J. Agronomy & Crop Science* 195: 427–441.
- [23] Sridevi, V., Chellamuthu, V. (2015): Growth analysis and yield of rice as affected by different systems of rice intensification (SRI) practices. – *International Journal of Research in Applied, Natural and Social Sciences* 3(4): 29–36.
- [24] Talbi, S., Rojas, J. A., Sahrawy, M., Rodríguez-Serrano, M., Cárdenas, K. E., Debouba, M., Sandalio, L. M. (2020): Effect of drought on growth, photosynthesis and total antioxidant capacity of the Saharan plant *Oudeneya africana*. – *Environmental and Experimental Botany* 176: 104099.
- [25] Thu, N. B. A., Nguyen, Q. T., Hoang, X. L. T., Thao, N. P., Tran, L. S. P. (2014): Evaluation of drought tolerance of the Vietnamese soybean cultivars provides potential resources for soybean production and genetic engineering. – *BioMed Research International* 2014: 1–9.
- [26] Zulfikar, F., Younis, A., Riaz, A., Mansoor, F., Hameed, M., Akram, N. A., Abideen, Z. (2020): Morpho-anatomical adaptations of two tagetes erecta l. Cultivars with contrasting response to drought stress. – *Pakistan Journal of Botany* 52(3): 801–810.

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14 Juli : Galley proof

The screenshot shows a Yahoo! Mail interface. The top navigation bar includes links for HOME, MAIL, NEWS, FINANCE, SPORTS, ENTERTAINMENT, LIFE, SEARCH, SHOPPING, YAHOO PLUS, and MORE... The search bar contains the text "Find messages, documents, photos or people". The left sidebar shows the "Compose" button and a list of folders: Inbox (436), Unread, Starred, Drafts (30), Sent, Archive, Spam, Trash, and Less. The main content area displays an email from "Applied Ecology" (aeerjournal@gmail.com) to "Achmad Fatchul Aziez" dated Thursday, July 14 at 3:29 PM. The email body reads: "Dear Author, We are sending you attached the galley proof of your manuscript (ref. 13439). Please check and approve it for publication or make any necessary final correction. Thank you in advance! Best regards, Technical Editors Applied Ecology and Environmental Research Open Access International Scientific Journal http://www.aloki.hu/". A "y!mail" advertisement is visible on the right side of the email content area.

14 Juli : Galley proof (Lanjutan)

The screenshot shows a Yahoo! Mail interface. The top navigation bar is identical to the previous screenshot. The left sidebar shows the "Compose" button and a list of folders: Inbox (436), Unread, Starred, Drafts (30), Sent, Archive, Spam, Trash, and Less. The main content area displays a response email from "Achmad Fatchul Aziez" (achmad.aziez@yahoo.com) to "Applied Ecology" dated Thursday, July 14 at 6:03 PM. The email body reads: "Dear Editor-in-Chief". Above the email, there is a "Download all attachments as a zip file" link and two attachment icons: "13439.pdf" (225 KiB) and "13439.doc" (446 KiB). A "y!mail" advertisement is visible on the right side of the email content area.

14 Juli : Galley proof (tanggapan author kepada editor)

The screenshot shows a Yahoo! Mail interface. The email is from Achmad Fatchul Aziez (achmad.aziez@yahoo.com) to the Editor-in-Chief of Applied Ecology, dated Thursday, July 14 at 6:03 PM. The email content is as follows:

Dear Editor-in-Chief

I have received a copy of my paper and I have read it but there is a slight error in the 4th line abstract that says **three** should be **four**. Henceforth, my paper with ref.13439 can be directly published in Applied Ecology and Environmental Research.

Thank you

Best regards,
Achmad Fatchul Aziez

Below the email text is a "Show original message" link and a small thumbnail of a document icon.

28 Juli 2022 : Online first

The screenshot shows a Yahoo! Mail interface. The email is from Applied Ecology (aeerjournal@gmail.com) to achmad.aziez@yahoo.com, dated Thursday, July 28 at 3:29 PM. The email content is as follows:

Dear Authors,

It is our pleasure to inform you that your paper has been published as OnlineFirst on the homepage of Applied Ecology and Environmental Research.
It is accessible through the following link:
<http://aloki.hu/indvoLOF.htm>

With best regards,

Technical Editors
Applied Ecology and Environmental Research
Open Access International Scientific Journal
<http://www.aloki.hu/>

At the bottom of the email, there are navigation icons (back, forward, etc.) and a "Reply, Reply All or Forward" button.

30 Juli 2022 : Published
https://www.aloki.hu/indvol20_4.htm

The screenshot shows a web browser window with the address bar displaying [aloki.hu/indvol20_4.htm](https://www.aloki.hu/indvol20_4.htm). The main content area displays a PDF document titled "2004_35693580.pdf" at 79% zoom. The document is titled "THE EFFECT OF DROUGHT STRESS ON THE GROWTH AND YIELD OF SOYBEAN (*GLYCINE MAX L.*)" by AZIEZ, A. F.^{1*}, PRASETYO, A.¹, and PAIMAN². The authors' affiliations are listed as the Department of Agrotechnology, Faculty of Agriculture, Universitas Tunas Pembangunan, Surakarta 57139, Indonesia. The abstract discusses the impact of drought stress on soybean growth and yield, mentioning stunted growth and reduced yield. The introduction states that drought stress significantly reduces agricultural productivity worldwide, particularly in soybean (*Glycine max L.*) seeds. The left sidebar contains a list of other articles, including "ON DEGRADATION MECHANISM OF CORN STRAW BY DIFFERENT FUNGI IN NON-SOIL ENVIRONMENT", "THE EFFECT OF DROUGHT STRESS ON THE GROWTH AND YIELD OF SOYBEAN (*GLYCINE MAX L.*)", "BROWN BEAR (*URSUS ARCTOS*) POPULATION DENSITY IN THE EASTERN BLACK SEA MOUNTAINS IN TURKIYE", "DIFFERENCES IN THE STRUCTURAL AND FUNCTIONAL TRAITS OF *POPULUS EUPHRATICA* AND *POPULUS PRUNOSA* WITH TREE HEIGHT", "SELECTING FEATURE MAP CLASSIFICATION AND ORDINATION OF ENDANGERED MEDICINAL PLANT (*GLYCYRRHIZA URALENSIS*) COMMUNITIES IN NORTH CHINA", "IN-SITU MONITORING OF WATER INFILTRATION RECHARGE IN LARGE DEPTH IRRIGATION AREA UNDER PLANTING CONDITIONS", and "NUTRITIONAL". The browser's taskbar at the bottom shows the time as 4:53 PM on 8/15/2022.