PHYSIOMORPHOLOGIS RESPONSE OF COWPEA (*Vigna unguiculata* L.) AT VARIOUS OF SOIL MOISTURE CONTENT

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ABSTRACT

A research was carried out to know morphophysiologis character and soil moisture content tolerance of cowpea at various of growth stages. The research was conducted at Green House and Research Laboratory of Agriculture Faculty of Universitas Muhammadiyah Yogyakarta from January to April 2016. The research was arranged in a field research method with one factor design in a Completely Randome Design. The traetment was consisted of soil moisture content i.e. 100%, 75%, 50%, 25% of water were each add in vegetatif stage, flowering stage and podding stage. The result of the researh showed that soil moisture content at various of growth stages has non significant influence to physiomorphologis character of cowpea, except to flowering dates and relative growth rate in vegetatif stage. Soil moisture content at 25% of water was significant to accelerated of flowering dates and significant to decreased of relative growth rate. Cowpea has tolerance to soil moisture content until 25% of water at various of growth stages.

Keywords: Cowpea, Physiomorphologis, Soil Moisture Content, Growth Stages,

INTRODUCTION

Indonesia is the fourth with biggest population country in the world. In 2013 according to Dickson (2013), the total population reached 251.160.124 inhabitants and increased in 2014 became 254.862.034 inhabitants (Batlolone, 2014). It keeps growing causes the amount of food needs increase as well. National food needs increase up to 1.35% every year (Waris, 2015). Food fulfillment needs productive soil for producing process. However, the productive soil area keeps declining in Indonesia due to functional changes of agricultural land into non-agricultural land, such as habitation or industry. One of attempt to resolve this issue is enlarging crop planting area to marginal land.

Marginal land is a land with low soil fertility. Dry land is one of marginal land. Indonesia has 63.4 million ha of dry land equals to 33.7% of the total area of Indonesia (Wahyunto and Rizantus, 2010). Furthermore, climate change leads to drought in part area of Indonesia. In 2014, 86 district of 20 province in Indonesia sustained dry (Kompas, 2014). Nonetheless, it has potential to support in developing production of agriculture, especially crop, yet for region with dry climate and high potential of drought should concern over choosing which crop resistant to drought.

The obstacle of dry land with dry climate is the limited supply of water because of the low rainfall plus long drought itself. Dry land has less capacity of moisture content compare to the land in a court. So, the water content in the soil could not fill up the plant needs. The amount of water needs in every growing stage of plant during its cycle is different. It is related to the process of physiological, morphological, and the combination of those factors plus environmental factors. The lack of water influences physiological and morphological activities for plant. It also causes different impact in every growth stage. Therefore, the crop that plant in a dry land should have a high tolerance over drought.

One of crops resistant to drought comes from bean family, is cowpea. The best thing of cowpea is its low grease degree, so it could minimalize the negative effect of using grease food product. Cowpea also contains higher B1 vitamin than green peal. According to Bean/Cowpea CRSP West Africa Mission, cowpea is known well-tolerant over drought compare to soybean or green peal because it tends to have deep root. It can grow in a dry area, even with only 300 mm rainfall (Gomez, 2004). Nonetheless, it shows different morphophysiologis reaction in every different level of soil moisture content in every growth stage. This research was carried out to know morphophysiologis character and soil moisture content tolerance of cowpea at growth stage.

MATERIALS AND METHODS

The research was conducted at Green House and Research Laboratory of Agriculture Faculty of Universitas Muhammadiyah Yogyakarta from January to April 2016. The seed that used are cowpea seeds varieties KT-6, regosol soil, compost, SP-36 fertilizer, KCI, Urea and water. The tools that used are polybag, gembor, soil sieve, analytical balance, calipers, oven, measurer, cetok, leaf area meter, petri-dish, filter paper, measuring cup, weighing bottle, desiccator, beaker, static, and gauze.

The research was arranged in a field research method with one factor design in a Completely Randome Design. The traetment was consisted of soil moisture content i.e. 100%, 75%, 50%, 25% of water supply were each add in vegetatif stage, flowering stage and podding stage. Therefore, there are 12 treatments. Each treatment repeated three times, resulting 36 units of treatment. Every unit of treatment consist 3 sample crops and 4 sacrifice crops.

10 kg of regosol soil mixed with 5 ton/ha compost equals to 12.82 gram/polybag, 100kg/ha SP-36 equals to 0.26 gram/polybag and 50 kg/ha KCI equals to 0.13 gram/polybag (Andrianto and Indarto, 2004). Plant 2 cowpea seeds in each polybag with depth around 2 cm from ground level. After one week, do thinning, so there is only one crop in every polybag.

In the early growth (0-7 days after implantation), the watering is done once a day in every afternoon with maintaining water volume at 100% soil moisture content of water supply. Add 2.540 ml/polybag water at the first day of implantation. Then add water using gravimetric method the next day until the 7th day. It is a method that adding water accordance with reducing weight per polybag. 4 polybag is taken to calculate its weight and take the average weight. The polybag weight should be maintained at 12.5 kg. The next watering is done according to treatment. The weeding is done mechanically by pulling the grass out of crop area. Pest and disease control is done by spraying insecticide. First fertilization is done at 14th day with 0.13 gram urea/polybag by making a shallow trench around the crop, then insert and pile up the urea (ring placement). The second fertilization is done at 28th day using the same method.

Treatment at vegetative stage (day 8-39), flowering stage (day 40-50) and podding stage (day 51-56). Watering is done once a day in every afternoon. In each treatment, three polybag weighed and averaged every day. One crop weighed its fresh weight once in every 14 day as correction factor. Treatment of moisture content with 100% water supply, maintain polybag weight at 12.5 kg. Treatment of moisture content with 75% water supply, maintain polybag weight at 11.9 kg. Treatment of moisture content with 50% water supply, maintain polybag weight at 11.3 kg. Treatment of moisture content with 25% water supply, maintain polybag weight at 10.6 kg. The amount of adding water could be calculated by adding the maintain weight of polybag and correction weight of the plant minus polybag weight. Harvest cowpea after 65 days of implantation, carried out pod color is green to yellow and/or brown, and part of the leaves is yellow or even fall off.

Parameters were observed of crop height, rod diameter, number of leaf, flowering age, number of pod each crop, number of seed each pod, pod weight each crop, seed weight each crop, seed weight each pod, weight of fresh plant canopy (fresh weight header), fresh root weight, root volume, leaf area, shoot dry weight, root dry weight, Relative Growth Rate (RGR), Net Assimilation Rate (NAR), Leaf Area Ratio (LAR), Specific Leaf Area (SLA), Shoot Root Ratio.

The result of observation delivered periodically in histogram and graphic, while the last result, at 5% rate, analyzed using analysis of variance (ANOVA). To know the significant influence of different treatment, there was further experiment with Duncan's Multiple Range Test (DMRT), at 5% rate.

RESULTS AND DISCUSSION

The result of this research shows different degree of soil moisture content in different growth stage render insignificant influence over height of crop, rod diameter, number of leaf, leaf area, (Table 1), weight of fresh plant canopy, shoot dry weight, fresh root weight, root dry weight (Table 2),root volume, net assimilation rate (Table 3), leaf area ratio, specific leaf area, shoot root ratio, number of pod each crop, number of seed each crop, number of seed each pod, pod weight each crop, seed weight each crop, seed weight each pod (Table 4). However it shows significant influence over flowering age (Table 2) and net assimilation rate at vegetative stage (Table 3).

Crop height. The result of treatment in soil moisture content at 100%, 75%, 50%, and 25% water supply, shows that metabolism process, reflected in cowpea tall, does not influenced because it has character that resist to drought. Moreover, the character leads cowpea to survive until reach withered level, so the crop height is still can be maximum until the last vegetative stage. The crop could absorb nutrient optimally and photosynthesis that goes smoothly causes the raise of crop height. It is agree with Basri (1996) that state, the water supply means there are enough nutrients in the ground. Growth stage with enough water supply make nutrients absorb and photosynthesis rate going smoothly so it can increase plant growth itself (Evita, 2012)

Rod Diameter. Cowpea could absorb nutrient optimally and photosynthesis process is running well with treatment soil moisture content of 100%, 75%, 50% and 25% water supply so it could raise the rod diameter. As much as water supply in plant cells, the fission could easily occur and make rod diameter getting bigger. At vegetative growth step, plant use water to do fission and cell enlargement embodied in increasing crop height, diameter enlargement, increase umber of leaf and growing root (Kremer, 1969 in Jafar et al, 2012)

Number of leaf. During vegetative stage, the supply water around the cowpea root could be used to carry out photosynthesis optimally. That way, the crop could use the result of assimilates for adding number of leaf. During disposal stage and podding stage, most of assimilates result used for flower formation and seed so vegetative organ, such as leaf, is no longer increasing its number. Soemartono (1990) in Jafar et al. (2012), state that water is very needed in every plant physiological process, including cells fission and leaf formation process. Water serves as a solvent for plant, to dissolve nutrient contained in the soil, then for photosynthesis process. Sufficient nutrient availability supports well-photosynthesis process and produce good fotosintat which use for leaf formation.

Leaf Area. During vegetative stage, cowpea could maintain turgiditas of plant cells so it could do leaf cell fission. At disposal and last filling stage, pod is no longer enlarging leaf area due to assimilate result redirected to growing generative organ. The decreasing of number of leaf causes leaf area diminished as well.

Flowering Age. The lack of water in plant causes flowering process gets faster. A plant with lack of water will produce high ABA hormone. It is agree with Prawiranata, Harran and Tjondronegoro (1994) in Evita (2012), that the raise of ABA hormone concentrate causes guard cells losing water and stomata begin to close, which makes transpiration rate reduced and plant could save water inside and survive its life. Furthermore, high concentrate of ABA hormone would inhibit the auxin and cytokinins activity making vegetative growth stunted. This makes the outcome of photosynthesis can not be used for developing vegetative. Therefore, the use of it leads for developing reproduction organs, such as flower formation.

Weight of fresh plant canopy (fresh weight header). Cowpea has endurance over soil moisture content. Therefore, it can use water supply to grow and thrive. During disposal and podding stage, water redirected to for flower and fill pod, so it does not have influence over weight header. The water supply in protoplasm help in growing and thriving cells, also form an active-fission network. It is accordance to Sumani (2010) in Purba et al. (2014) who state that water is an essential part for protoplasm and create 80-90% of fresh weight of an active-growing network.

Shoot Dry Weight. Plant dry weight, in the form of total biomass, known as a manifestation of metabolism process that occur in plant. Plant biomass includes the result of photosynthesis, nutrient and water uptake. Dry weight can show the plant productivity because 90% of result of photosynthesis is form in dry weight (Gardner et al., 1991). At the last vegetative stage, there is no significant influence of soil moisture content. Treatment of soil moisture content with 75%, 50%, and 25% water supply over other plant than cowpea shows less-value of dry weight at vegetative stage. It is caused by the lack of needed water for photosynthesis than soil moisture content with 100% water supply. During disposal and podding stage, water in the plant cells used to form flower and pod with its seed. Therefore, it influence shoot dry weight.

Fresh Root Weight. Water supply in cowpea could maintain turgiditas of plant cells causes fresh root to survive. Water supply in the ground will maximize plant growth and raise the plant weight, especially root. The amount of absorbed water will be diffused to every unit of plant organ.

Dry Root Weight. Effendi (1982) in Jasminarni (2008) states that the effect of water stresses forces the crop to grow root hair for easily absorb water. This root hair grows in a short period for then faded and replaced by new one. The consumed energy to grow root hair, obstruct other root to grow bigger so the number of root is smaller.

Root Volume. According to Sugiyanto (2008) in Jafar et al. (2012), water and nutrient absorbing by end of root influence the root growth so that occur balance of root volume and growth of the crop.

Net Assimilate Rate. Net assimilation rate is the net result of assimilation, most of it taken from result of photosynthesis result for each unit leaf area and time. It is connected with cowpea relative growth rate. Wibowo (2006) in Sari (2008) states, the increasing number of NAR influenced by increasing plant growth rate, because accretion of new material is close related to the ability of its plant to carry out photosynthesis.

Relative Growth Rate. Relative growth rate shows increasing dry weight in one time interval, in a cope of original weight. Relative growth rate is influenced by lessening number of leaf and occur leaf aging cause slowing down of photosynthesis process. According to Gadner et al. (1991), relative growth rate at crop is generally start slowly, then it goes faster after germination to eventually getting slow down.

Leaf Area Ratio. Leaf area ration shows ration between lamina area of leaf (networks that carry out photosynthesis) and total biomass plant (total plant network that carry out respiration). The same influence over wide ratio allegedly caused by all soil moisture content, supply water for photosynthesis, and optimally fulfillment of respiration. Then the ratio between network that carry out photosynthesis and network that carry out respiration has no significant difference.

Specific Leaf Area. Specific leaf area is quotient over leaf area towards leaf weight. The index contains leaf thickness information that can reflect Photosynthetic organelles unit. The big value of specific leaf area indicates the leaf is thin and specific (Gardner et al., 1991). The same influence allegedly caused the water need for photosynthesis is fully fulfilled and fotosintat could be used to add leaf thickness.

The Ratio of Water Header. The ratio of water header depicts the connection of growth comparison between root and its crown. The allometric growth of crown and root (known as ratio of water header) does have physiological interest. Ration of water header could depict one of tolerance form over drought. Ratio of water header controlled by either genetical or environmental factor (Gardner et al., 1991). The same influence in every treatment allegedly due to the optimal utilization of water supply, which contain in each soil moisture content, to grow crown (head) and root.

Number of Pod each Crop, Number Seed each Crop, and Number Seed each Pod. The differences of soil moisture content do not give a significant influence over cowpea because it can utilize the supply water optimally to form pod and seed. During vegetative stage, most of fotosintat used to fission vegetative crop cells, such as stem, leaf, and root. During disposal stage, fotosintat used to form flower and during podding stage, the fotosintat used to form pod and seed. Gardner et al. (1991), state that lack of water during filling stage reduces number of seed due to decreasing photosynthesis rate process. Lack of water during plant growth causes low number of seed because the relocated of fotosintat to fill the seed is low as well.

Pod weight each crop, seed weight each crop, Seed weight each pod, and result per hectare. Lack of water during vegetative stage cause vegetative plant organ could not fully form so the result of photosynthesis is not as much as plant with optimum vegetative organ and it influence the next step (disposal stage and podding stage). Lack of water during disposal stage cause result of photosynthesis to form flower does not forming much flower which then influence forming seed process. The lack of water during podding stage causes the reduced weight. Somaatmadja (1985) in Nugraha et al. (2014) state that lack of water at forming flower until podding stage will cause less seed created with small size of seed, so it reduced weight.

Soil moisture content with 25% water supply at vegetative stage, soil moisture content with 75%, 50%, and 25% water supply at disposal stage, soil moisture content with 50% and 25% water supply at podding stage tend to reduce the produce of cowpea than cowpea at soil moisture content with 100% water supply in every stage. Base on that, cowpea should be at soil moisture content available above 25% during vegetative stage and soil moisture content available above 75% during disposal and podding stage. It is disclosed by Adisarwanto et al. (1998) that even though cowpea crop does not need much water but it is sought to free from the long drought during disposal and podding period.

CONCLUSIONS and SUGGESTION

1. The soil moisture content in each growth stage has no significant effect over morphophysiologis character of cowpea, but in flowering age and relative growth rate in vegetative stage. The soil moisture content with 25% water supply in vegetative stage shows in accelerating flowering age and decreasing the rate of relative growth of cowpea crop
2. Cowpea crop has a tolerance of soil moisture content until 25% degree of water supply at every growth stages.

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Table 1. The Average Number of Crop Height, Rod Diameter, Number of Leaf and Leaf Area in every drought level in the last vegetative growth stage (5 mst), last flowering stage (6mst) and last pod-filling stage (8 mst)

Treatment	Crop Height (cm)			Rod Diameter (cm)			Number of Leaf (leaf)			Leaf Area (cm^2)		
	5 mst	6 mst	8 mst	5 mst	6 mst	8 mst	5 mst	6 mst	8 mst	5 mst	6 mst	8 mst
SMC 100% water supply at vegetative stage	47,22 a	47,39 a	47,44 a	0,3767 a	0,3833 a	0,3900 a	29,11 a	24,11 a	15,11 a	1528,3 a	1296,3 a	980,0 a
SMC 75% water supply at vegetative stage	47,64 a	47,70 a	47,73 a	0,3633 a	0,3700 a	0,3700 a	25,11 a	23,22 a	14,56 a	1195,3 a	1099,0 a	982,3 a
SMC 750% water supply at vegetative stage	43,78 a	46,29 a	46,33 a	0,3800 a	0,3900 a	0,3933 a	23,56 a	22,44 a	14,33 a	1120,0 a	1069,7 a	969,3 a
SMC 25% water supply at vegetative stage	37,89 a	42,04 a	42,16 a	0,3033 a	0,3167 a	0,3200 a	23,44 a	21,89 a	12,33 a	1082,7 a	1045,0 a	727,7 a
SMC 100% water supply at flowering stage	49,18 a	49,18 a	49,21 a	0,5067 a	0,5067 a	0,5067 a	26,89 a	24,67 a	20,44 a	2171,3 a	1883,7 a	1694,7 a
SMC 75% water supply at flowering stage	49,26 a	49,27 a	49,29 a	0,3633 a	0,3233 a	0,3300 a	25,78 a	24,33 a	19,00 a	1436,3 a	1289,3 a	893,7 a
SMC 50% water supply at flowering stage	46,83 a	46,89 a	46,92 a	0,4867 a	0,4900 a	0,4900 a	26,44 a	23,67 a	16,00 a	1702,7 a	809,3 a	777,7 a
SMC 25% water supply at flowering stage	46,84 a	48,16 a	48,21 a	0,3300 a	0,3433 a	0,3500 a	27,11 a	21,00 a	13,67 a	1459,0 a	751,0 a	640,7 a
SMC 100% water supply at pod-filling stage	54,46 a	54,46 a	54,51 a	0,5133 a	0,5200 a	0,5233 a	26,56 a	23,44 a	14,22 a	1648,0 a	1616,7 a	1041,7 a
SMC 75% water supply at pod-filling stage	46,17 a	46,19 a	46,20 a	0,3467 a	0,3267 a	0,3300 a	26,78 a	24,33 a	12,22 a	1299,3 a	1113,0 a	754,3 a
SMC 50% water supply at pod-filling stage	44,39 a	47,48 a	47,53 a	0,3867 a	0,3967 a	0,3967 a	25,44 a	22,00 a	9,67 a	1322,7 a	1154,7 a	721,7 a
SMC 25% water supply at pod-filling stage	43,94 a	44,28 a	44,33 a	0,4500 a	0,4567 a	0,4600 a	28,67 a	27,67 a	8,11 a	1341,3 a	1323,3 a	542,7 a

Note: the number following by the same letter has no significant according to variance in the errors level at 5%. SMC= Soil Moisture Content, mst=minggu setelah tanam (week after implantation)

Table 2. The Average Number of Flowering Age, Fresh Weight Header, Shoot Dry Weight, Fresh Root Weight, and Dry Root Weight in every drought level at the last vegetative growth stage (5 mst), last flowering stage (6mst) and last pod-filling stage (8 mst)

Treatment	Flowering age	Fresh weight header (gram)			Shoot dry weight (gram)			Fresh root weight (gram)			Dry root weight (gram)		
		5 mst	6 mst	8 mst	5 mst	6 mst	8 mst	5 mst	6 mst	8 mst	5 mst	6 mst	8 mst
SMC 100% water supply at vegetative stage	38,00 a	79,63 a	59,58 a	52,14 a	10,87 a	10,84 a	8,02 a	14,19 a	12,49 a	7,56 a	2,5133 a	2,2300 a	1,2433 a
SMC 75% water supply at vegetative stage	39,67 a	50,34 a	45,65 a	43,71 a	7,87 a	7,26 a	7,68 a	7,37 a	6,33 a	5,22 a	1,2067 a	1,1867 a	1,0867 a
SMC 50% water supply at vegetative stage	37,33 ab	48,10 a	46,96 a	39,00 a	7,87 a	6,20 a	5,52 a	7,15 a	6,22 a	5,84 a	1,1567 a	1,1033 a	1,0300 a
SMC 25% water supply at vegetative stage	35,33 b	41,68 a	40,57 a	36,92 a	6,62 a	6,62 a	5,72 a	6,30 a	4,96 a	4,21 a	1,1300 a	0,9967 a	0,9500 a
SMC 100% water supply at flowering stage	39,33 a	97,35 a	91,28 a	77,08 a	13,73 a	13,71 a	12,55 a	20,67 a	13,80 a	12,75 a	2,8967 a	2,6133 a	2,3967 a
SMC 75% water supply at flowering stage	39,33 a	50,45 a	41,00 a	39,97 a	8,04 a	7,27 a	6,77 a	13,11 a	8,76 a	7,26 a	2,6200 a	1,0033 a	0,9100 a
SMC 50% water supply at flowering stage	39,67 a	74,54 a	69,77 a	40,89 a	12,70 a	6,73 a	6,03 a	9,18 a	8,29 a	8,67 a	1,9733 a	0,9433 a	0,9067 a
SMC 25% water supply at flowering stage	39,00 a	50,91 a	45,18 a	34,93 a	10,55 a	5,16 a	5,06 a	8,00 a	7,93 a	6,63 a	1,3433 a	0,9300 a	0,9033 a
SMC 100% water supply at pod-filling stage	39,33 a	74,09 a	70,29 a	66,20 a	11,29 a	11,20 a	8,86 a	24,73 a	9,24 a	8,63 a	2,2500 a	1,9433 a	1,4200 a
SMC 75% water supply at pod-filling stage	38,67 a	70,04 a	63,20 a	47,13 a	8,48 a	8,36 a	6,26 a	7,77 a	6,64 a	5,77 a	1,4900 a	1,7367 a	1,2267 a
SMC 50% water supply at pod-filling stage	39,67 a	61,95 a	53,67 a	47,92 a	9,78 a	7,32 a	5,80 a	9,97 a	7,80 a	5,40 a	1,8200 a	1,3133 a	0,6567 a
SMC 25% water supply at pod-filling stage	39,00 a	56,80 a	46,32 a	34,67 a	8,17 a	7,71 a	5,61 a	8,34 a	7,59 a	3,93 a	1,3367 a	1,2233 a	0,6167 a

Note: the number following by the same letter has no significant according to variance in the errors level at 5%. SMC= Soil Moisture Content, mst=minggu setelah tanam (week after implantation)

Table 3. Table of Root Volume, Net Assimilate Rate (NAR), Relative Growth Rate (RGR), Leaf Area Ratio (LAR) in every drought level at the last vegetative growth stage (5 mst), last flowering stage (6mst) and last pod-filling stage (8 mst)

Treatment	Root Volume			NAR (g/cm2/minggu)			RGR (g/g/minggu)			LAR (cm2/g)		
	5 mst	6 mst	8 mst	5 mst	6 mst	8 mst	5 mst	6 mst	8 mst	5 mst	6 mst	8 mst
SMC 100% water supply at vegetative stage	60.33 a	46.67 a	17,33 a	0.08323 a	0.07470 a	0.06503 a	2.55 ab	2.54 a	2.16 a	171.74 a	142.11 a	136.45 a
SMC 75% water supply at vegetative stage	59.33 a	56.67 a	12,67 a	0.06400 a	0.06287 a	0.05390 a	2.19 bc	2.13 a	2.12 a	123.50 a	112.61 a	112.55 a
SMC 50% water supply at vegetative stage	64.00 a	50.00 a	25,33 a	0.06140 a	0.05660 a	0.04263 a	2.18 bc	2.10 a	2.02 a	117.21 a	111.12 a	109.83 a
SMC 25% water supply at vegetative stage	77.33 a	56.67 a	34,67 a	0.05677 a	0.05653 a	0.04927 a	2.03 c	1.97 a	1.83 a	112.07 a	103.32 a	92.76 a
SMC 100% water supply at flowering stage	55.00 a	40.00 a	34,33 a	0.06803 a	0.06533 a	0.06263 a	2.79 a	2.79 a	2.68 a	205.38 a	138.57 a	127.14 a
SMC 75% water supply at flowering stage	52.33 a	50.00 a	9,67 a	0.10103 a	0.06327 a	0.06220 a	2.37 abc	1.96 a	1.93 a	136.03 a	134.98 a	116.04 a
SMC 50% water supply at flowering stage	67.00 a	60.00 a	17,00 a	0.14830 a	0.05467 a	0.05253 a	2.64 ab	1.81 a	1.81 a	149.57 a	132.08 a	115.96 a
SMC 25% water supply at flowering stage	61.67 a	46.67 a	8,00 a	0.09757 a	0.05430 a	0.04743 a	2.45 abc	1.80 a	1.70 a	132.66 a	128.22 a	100.29 a
SMC 100% water supply at pod-filling stage	54.33 a	46.67 a	24,00 a	0.08033 a	0.07017 a	0.06790 a	2.56 ab	2.43 a	2.29 a	217.18 a	137.67 a	125.35 a
SMC 75% water supply at pod-filling stage	64.67 a	46.67 a	15,00 a	0.07377 a	0.06737 a	0.06053 a	2.43 abc	2.27 a	2.01 a	126.54 a	123.10 a	111.15 a
SMC 50% water supply at pod-filling stage	64.33 a	50.00 a	23,00 a	0.15493 a	0.10100 a	0.05723 a	2.25 bc	2.14 a	1.79 a	139.31 a	138.05 a	100.46 a
SMC 25% water supply at pod-filling stage	76.00 a	46.67 a	16,00 a	0.07347 a	0.06440 a	0.05210 a	2.30 bc	2.00 a	1.79 a	150.54 a	135.89 a	98.78 a

Note: the number following by the same letter has no significant according to variance and DMRT in the errors level at 5%. SMC= Soil Moisture Content, mst=minggu setelah tanam (week after implantation)

Annex 4. Table of Specific Leaf Area (SLA), Ratio of Water Header (RWH), Number of Pod each Crop, Number of Seed each Crop, Number of Seed each Pod, Pod Weight each Crop, Seed Weight each Pod, Seed Weight each Crop, and the Result in every drought level at the last vegetative growth stage (5 mst), last flowering stage (6mst) and last pod-filling stage (8 mst)**.**

Treatment	SLA (cm2/g)			RWH			Number of Pod each Crop	Number of Seed each Crop	Number of Seed each Pod	Pod Weight each Crop (gram)	Seed Weight each Pod (gram)	Seed Weight each Crop (gram)	Result (t/ha)
	5 mst	6 mst	8 mst	5 mst	6 mst	8 mst							
SMC 100% water supply at vegetative stage	70,02 a	48,48 a	25,70 a	7,54 a	7,12 a	6,81 a	4,00 a	43,67 a	10,92 a	10,80 a	1,39 a	5,47 a	2,19 a
SMC 75% water supply at vegetative stage	137,92 a	57,40 a	44,83 a	7,24 a	7,00 a	6,46 a	5,00 a	54,00 a	10,53 a	10,88 a	1,39 a	5,47 a	2,19 a
SMC 50% water supply at vegetative stage	139,50 a	57,06 a	43,03 a	7,03 a	6,12 a	5,17 a	4,00 a	41,67 a	10,52 a	8,87 a	1,07 a	5,19 a	2,08 a
SMC 25% water supply at vegetative stage	282,40 a	68,69 a	47,38 a	6,74 a	6,09 a	5,60 a	2,67 a	25,67 a	9,22 a	8,07 a	1,19 a	3,10 a	1,24 a
SMC 100% water supply at flowering stage	64,03 a	46,48 a	32,70 a	8,37 a	8,09 a	7,16 a	4,67 a	48,33 a	10,75 a	9,07 a	1,39 a	6,26 a	2,50 a
SMC 75% water supply at flowering stage	77,00 a	50,17 a	38,38 a	7,60 a	6,37 a	6,29 a	4,33 a	34,67 a	8,44 a	7,30 a	1,32 a	4,53 a	1,81 a
SMC 50% water supply at flowering stage	88,60 a	73,17 a	55,51 a	8,57 a	6,31 a	5,56 a	3,00 a	38,00 a	12,64 a	8,80 a	1,05 a	4,46 a	1,78 a
SMC 25% water supply at flowering stage	117,70 a	93,28 a	66,51 a	8,36 a	5,91 a	4,37 a	4,33 a	40,33 a	9,67 a	6,77 a	0,92 a	3,69 a	1,48 a
SMC 100% water supply at pod-filling stage	97,23 a	45,69 a	23,40 a	8,29 a	7,36 a	5,54 a	3,67 a	38,33 a	12,00 a	10,64 a	1,96 a	5,57 a	2,23 a
SMC 75% water supply at pod-filling stage	66,55 a	54,01 a	40,80 a	11,74 a	8,78 a	5,46 a	3,67 a	34,00 a	9,22 a	15,67 a	1,37 a	4,93 a	1,97 a
SMC 50% water supply at pod-filling stage	57,85 a	63,59 a	42,30 a	9,15 a	7,06 a	5,40 a	3,67 a	34,33 a	9,44 a	11,33 a	1,37 a	4,71 a	1,88 a
SMC 25% water supply at pod-filling stage	117,65 a	48,62 a	46,50 a	8,99 a	7,35 a	3,29 a	3,67 a	38,00 a	10,53 a	8,12 a	0,95 a	4,48 a	1,39 a

Note: the number following by the same letter has no significant according to variance and DMRT in the errors level at 5%. SMC= Soil Moisture Content, mst=minggu setelah tanam (week after implantation)