Effect of water regime and organicamendment on agromorphologicalparameters of tomato (*Solanum lycopersycum* L.) grown in the open field on gleysol in Diabo department, central Côte d'Ivoire.

ABSTRACT

Objective: The aim of the studywas to improve the productivity of the PADMA 108 F1 tomatogrown in the field on gleysol in the off-season by the combined application of a water regime and an organicamendment.

Place and duration of study: The studytook place in the off-season (July-August) in 2022 at Yomian-Kouadiokro (7°49N, 5°9W) in the Gbêkêregion and Diabo department of central Côte d'Ivoire.

Methodology:After clearing a hydromorphicfallow more than 10 yearsold, microplotsweredelimited in completelyrandomized Fisher blocks of 3 replicates. In eachreplication, 12 microplots of 5m^{2}weredistributedin 03 blocks, eachcomprising 4 treatments (poultrymanure, sawdust, NPK12-22-22 fertilizer and no-fertilizer control). In eachmicroplot, 10seedpotswerecreated, intowhich the tomatoseedlingsweretransplanted. At transplanting, fertilizerwasapplied as a base dressing at a rate of 0.5 kg/pack (poultrydroppings and sawdust compost) and 85 g/pack of NPK around the tomato base, comparedwith a no-fertilizer control. Afterplanting, a regularwatering of 60 liters of water wasapplied to each block using a watering can (10L), subjecting the seedlings to a specificwateringregime of 7 waterings/week, 4 waterings/week and 2 waterings/week.

Results:ahighlysignificantspecificeffect of watering 7 times/week and organicamendment (poultrymanure compost) on agromorphologicalparameterswasobtainedwith the highest values comparedwith the othertreatments. On the other hand, the best values for tomatoagromorphologicalparameterswerenotedwith the combinedeffect of water regime 2 times/weekwithorganicamendment (poultrymanure compost), NPK12-22-22 fertilizer and sawdust compost to someextent.

Conclusion : Thisstudy shows that to improve the productivity of the PADMA 108 F1 tomato in the ecosystemstudied, a wateringregime of 2 waterings/weekissuitable, regardless of the type of treatmentapplied (organic or mineralfertilizers).

Key words: Water regime, organicamendment, tomato, agromorphologicalparameters, Diabo-Côte d'Ivoire.

1-INTRODUCTION

Agriculture represents the key sector of the Ivorianeconomy, occupying more than 60% of the working population and providing on average 30-35% of the grossdomesticproduct, [1]. Although the success of this agriculture is, primarily, based on cash crops, the country has nowadays, opted for a more diversified agriculture. This diversification has resulted in the development of annualcrops, includingvegetablecrops [2].Amongthesecrops, the tomato (*solanum lycopercicom* L.) has gained a place of choicewithproducers and consumers due to itsbiochemicalproperties, itsnutritional contribution and perfect for a variety of dishes, salads and homemade sauces (Rao and agarwal, 2000). As a result, marketgardening, in particular, tomato production has seenrapiddevelopment in recentyears, risingfrom31,241 tonnes in 2010 to 47,283 tonnes in 2020, with an averageyield of 10,392 t/ha [3-4-]. However, the development of tomato cultivation, like that of othervegetablecrops in our tropical regions, is not withoutitsconstraints. Production islimited by insufficient arable land, naturalsoilinfertility, lowsoil water retentioncapacity, high pest pressure, irregularrainfall due to climate change, and the lowagronomicpotential of local varieties.Theseconstraints are a major concern for farmerswhenitcomes to improvingtomatoyields. The use of chemicalfertilizers, because of theirimmediatebeneficialeffect on the productivity of vegetable and viral crops, has been considered as one of the solutions for meeting the nutrientrequirements of cultivated plants and increasingyields[5].However, their abusive use in cultivation practices is not withoutconsequences for the environment and people'shealth[6. In contrast, organicsoilimproverscouldbe an appropriate solution for restoringsoilfertility and improvingmarketgardeners' productivity[7-8]. In addition, irregularrainfallmanifested by water stress affects the physiologicalfunctioning of the plant, resulting in reducedgrowth and development of the crop[9-10] and itsproductivity[11].Facedwiththesethreats of continualsoilimpoverishment and rainfallvariability, itseems more thannecessary to find solutions aimed at preservingsoilfertility and moisture to improvemarketgardenyields. It istherefore opportune to set up cultivation techniques thatwouldreduce the use of chemicalproducts in favor of organicamendment and a program for adaptingtomato cultivation to drought conditions. The aim of thisstudyis to determine the combinedeffect of the water regime and the use of organicfertilizers in improvingtomatoproductivity in central Côte d'Ivoire.

2-METHODOLOGY

2-1. Presentation of the study site

The workwascarried out in Yomian-Kouadiokro (7°49'58.9'' N, 5°9'54'' W), a village located in the commune and sub-prefecture of Diabo, in central Côte d'Ivoire (Figure 1). The Diabo sub-prefecture area waschosenbecauseitisrich in agricultural activities, notablymarketgardening. It is an equatorialclimate zone, in transition betweensub-equatorial and sub-tropicalclimates, knownlocally as the Baouléen climate. There are four seasons, includingtwo dry seasons (the long seasonfromNovember to February and the short seasonfrom July to August) and tworainyseasons (the long seasonfrom March to June and the short seasonfromSeptember to October). The rainfallregimeistherefore bimodal, withannualprecipitationreaching 1.200 mm for an averagetemperature of around 27°C and relative air humidity of 70% [12]..Vegetationisessentiallyherbaceous, colonized by Imperatacylindrica[13] and the soil cover thatformedour substratum in thisstudyis the hydromorphicsoil cover (Gleysols) due to the heavy exploitation of this area for marketgardencrops.

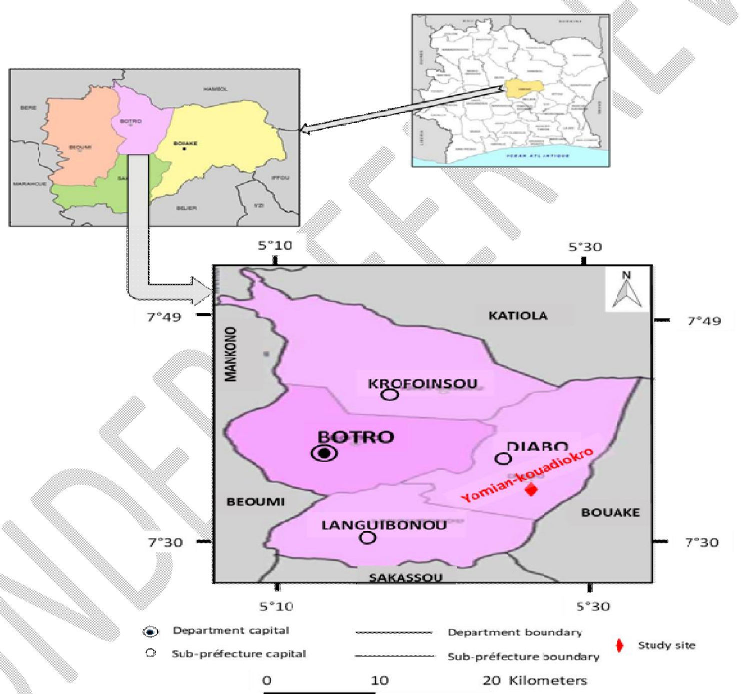

Figure 1: Administrative map of the Diabo sub-prefecture, showing the study site

2-2. Plant material

Seeds of the improvedtomato PADMA 108 F1 wereused as plant material in thisstudy (Figure 2). The choice of thisvarietywasguided by the local availability of seeds, itstolerance and resistance to disease, its good early production and itsuniform, rounded fruits with a redcolor at maturity. The

PADMA 108 F1 tomatois a short-cycle variety (75-80 days). It isknown for its excellent adaptation to hot, humidclimates, its high-yieldingquality and for itsfirmness, ensuring excellent post-harvestfirmness. It isalsohighlyappreciated for itsflavorful, versatile taste, perfect for a variety of dishes, salads and homemade sauces.

Figure 2: PADMA 108 F1 tomato (A = fruit and B = seed)

2-3. Fertilizingmaterials

This consisted of organicfertilizers (poultrydroppings and sawdust) and NPK 12-22-22 mineralfertilizers (Figure 3):

- The poultrydroppingsused came from a poultryfarm close to the study site at yomian-kouadiokro. Sawdustwascollectedfrom a sawmill in the Diabo sub-prefecture. Theseorganicfertilizerswereusedbecause of the interestmostmarket-gardenfarmers in the Diabo sub-prefecture place in them as organicsoilfertilizers. Poultrydroppings, like the sawdustsampled, werepiled and composted for eightmonths, with a view to reducing the volume of wastethroughdecomposition and acceleratingmineralization to makenutrientsavailable to the plant. At the end of the composting process, the resulting composts (poultrydroppings and sawdust) weredried and sieved to removeimpurities, thenpackagedbefore use.
- The mineralfertilizerusedwas NPK 12-22-22. It isoftenused for itsimmediatebeneficialeffect on vegetablecropproductivity.

Figure 3 : Fertilizersused (A : Compost frompoultrydroppings ; B : Compostfromsawdust : C : NPK 12-22-22 fertilizer

2-4. Nursery set-up and maintenance

The nursery was set up in trayspreviouslyfilledwithpottingsoil and consisted in burying the seed grains one by one in eachtraycontaining the pottingsoil. Aftersowing, the nursery waslightlymoistened and placedunder a shade to protectitfrom the sun's rays and accelerateseeddormancy and germination.

The nursery waswatereddaily to prevent the seedlingsfromwilting, and lastedapproximately 3 to 4 weeksbeforetransplanting.

2-5. Experimentalset-up, crop establishment and maintenance

In order to facilitaterooting and promote the growth and development of the cultivated plant, a hydromorphicfallow plot measuring 405 m^2 (27 m x 15 m) and over 10 yearsoldwascleanedwith a machete and cleared of plant debris, ploughed and weededwith a daba, beforestaking out the boundaries of the microplots, whichwere laid out in completelyrandomized Fisher blocks of 3 replicatesseparated by a 1.5 m row, eachwith 4 treatments (poultrymanure-PM, sawdust-SD, mineral fertilizer-NPK12-22-22 and fertilizer-free control-CO). Ineachreplication, twelve (12) microplots of 5 m^2 (5 m x 1 m) corresponding to the treatments and spaced 1 m apartweredistributed. In eachmicroplot, tomatoseedlings (PADMA 108 F1) werepricked out in 10 pots spaced 1 m apart.At transplanting, fertilizerswereapplied as basal fertilizer at a rate of 0.5 kg poultrydroppings compost per stake, 0.5 kg sawdust compost per stake and 85 g NPK within a 0.5 cm radius of the tomato plant. All these applications werecomparedwith a control withoutfertilizer, according to the experimentalset-upbelow (Figure 4). Afterplanting and fertilizer application, a water regimewasalsoapplied to the differentmicroplots of eachreplication. Eachmicroplotwasregularlywateredwith 60 liters of water using a watering can. The frequency of wateringwas 7 times a week, i.e. 1 wateringeveryday of the week; 4 times a week, i.e. 1 wateringeveryotherday; and 2 times a week, i.e. 1 wateringeverythirdday. Weeding and hand weedingwerecarried out as needed to eliminateweeds and preventtheirproliferation. Phytosanitarytreatmentwascarried out withmaneb (75 g in 16 L of water) as a preventivemeasure, and as a curative measure, the fieldwastreatedwith Lambda-cyhalotrin 25g/L (40 ml in 16 L of water) and mancozan 80 WP (mancozeb) to prevent and control the presence of pestsfrom the 20th dayaftertransplanting the plants until the end of the experiment. A fencewasbuiltaround the field to protect the tomato plants fromanimals.

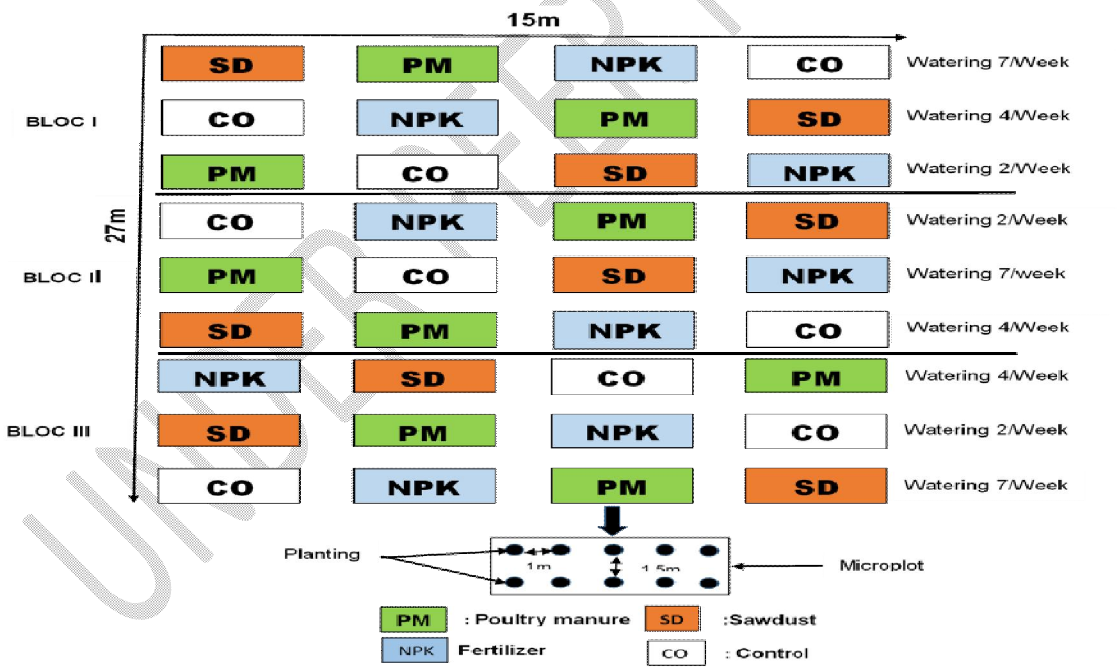

Figure 4:Schematicdiagram of the experimentalset-up

2-6. Data collection and analysis

During the development cycle of the tomato, growth and developmentparametersweredeterminedonly at the maturity stage and concerned:

- span, measuring the distance between the outermostlateralleaves

- Plant height, measuredwith a tapemeasure on the stem from the soil surface to the plant apex,
- the number of branches and fruits on the plant by simple counting.
- Fruit weight by simple weighing.

The data collected for eachcropwereentered and sortedusing Excel office 2019 spreadsheet and subjected to analysis of variance using STATISTICA 7.1 software. For each variable studied, meanswerecomparedtakingintoaccount water regimes, fertilizers (organic and mineral) and varietiesthrough a 3-factor analysis of variance (ANOVA 3). The significance of the test wasdetermined by comparing the probability (P) associatedwith the statistic at the threshold $\alpha = 0.05$. When a significantdifferencewasobservedbetween traits, the ANOVA wascompleted by the SmallestSignificantDifference (SSD) test, whichallows us to identifyhomogeneous groups.

3-RESULTS

3-1. Effect of water regime on variation in agro-morphologicalparameters

The different types of wateringapplied to tomato plants duringgrowth and developmentsignificantlyaffectedgrowth and yieldparameters (Table 1). With regard to growthparameters, wateringsignificantly ($P<0.05$) affected the height and spread of tomato plants, except for branching, whichhad non-significant values ($P>0.05$). Explicitly, therewas a significantdifference ($p < 0.010$) in height and spanwith an overallmean of 31, 36 cm for height and 12.47 cm for span. The greatestheight (36.17 cm) and span (13.58 cm) of the tomato plant werenotedwithwatering 7 times a week, whilewatering 4 times a week and 2 times a weekhadheights (29.50 cm) and (28.42 cm) respectively, which are alsostatisticallyidenticalheights. Similarly, the spread wassmaller (11.58 cm) withtwice-weeklywatering and intermediate (12.25 cm) with 4-times-weekly watering.Yieldparameters (fruit number and weight) werealsoaffected by the wateringregime, withstatisticallysignificant values ($P<0.05$) and an overallaverage of around 13 fruits per tomato plant for an average fruit weight of 3.33 grams. Fruit number and weightwerehighestwith 7-times-weekly watering, with an averagenumber of 17.50 fruits per tomato plant and an average fruit weight of 4.92 grams. The 4-times-a-week and 2-times-a-week wateringtreatmentshadstatisticallyidentical values, with 11.08 fruits per plant for 2.58 g fruit weightunder 4-times-a-week watering and 10.33 fruits per plant for 2.50 g fruit weightunder 2-times-a-week watering.

Table1:Effect of water regime on tomatogrowthparameters

	Water regimesapplied				
Paramters	Watering 7/Week	Watering 4/Week	Watering 2/week	*Mean*	*P value*
Height (cm)	36.17^{a}	29.50^{b}	28.42^{b}	31.36	0.010
Branching	13.67^{a}	14.17^{a}	12.83^{a}	13.55	0.457
Span (cm)	13.58^{a}	12.25^{ab}	11.58^{b}	12.47	0.051
Nomber of fruits	17.50^{a}	11.08^{b}	10.33^{b}	12.97	0.013
Fruitsweight (g)	4.92^{a}	2.58^{b}	2.50^{b}	3.33	0.009

Values followed by the sameletter in line are not significantlydifferent at the 5% threshold

3-2. Effect of fertilizers on variation in agro-morphologicalparameters

Table 2 shows the variation in tomato agro-morphologicalparametersunder the influence of the variousfertilizersapplied. It can beseenthat all the organic and mineralfertilizersappliedsignificantly ($p < 0.05$) affected the tomato's agro-morphologicalparameters, except for the value of span, whichwas non-significant ($p > 0.05$). Explicitly, an overallaverageheight of 31.36 cm with a branching of 13.55 branches of tomato plants werenotedwith the application of the differentfertilizers. However, the highestheights, althoughstatisticallyidentical, wereobservedwithpoultrymanure-PM (35.22 cm) and NPK (33.55 cm). Sawdust-SDhad the lowestheight (25.89 cm) comparedwith an intermediateheight (30.78cm) for the blank-CO control. A similar variation in branchingwasnotedwith the greatestnumber of branches (15.55) for poultrymanure-PM versus an intermediatenumberwith NPK (13.78). Sawdust-SD (12.11) and blank-CO (18.78) were the lowest and statisticallyidentical.Regardingyieldparameters (number of fruits and fruit weight), fertilizersaffectedthemsignificantly ($p < 0.05$) with an overallaverage of around 13 fruits per plant for a weight of 3.33 grams. Treatmentswithpoultrymanure-PM and NPK had a statisticallyidenticalnumber of fruits, with 15.78 fruits (poultrymanure-PM) and 16.67 fruits (NPK) per tomato plant, for an overallaverage of around 13 fruits per tomato plant. Sawdust-SDhad the lowest fruit count (8.44), while the blank-CO control showed an intermediate fruit count (11.00) per tomato plant. Similar fruit weightresultswereobtainedwith the highest NPK weight (5.11g) and the lowestsawdust-SD (1.78g) and blank control (2.44g), whichwerestatisticallyidentical. Fruit weightaffected by poultrydroppingswasintermediate (4.00g).

Table 2:Effect of fertilizers on tomatogrowthparameters

	Fertilizersapplied					
Parameters	PM	SD	NPK	CO	*Mean*	*P value*
Height (cm)	35.22^{a}	25.89^{b}	33.55^{a}	30.78^{ab}	31.36	0.022
Branching	15.55^{a}	12.11^{b}	13.78^{ab}	12.78^{b}	13.55	0.021
Span (cm)	13.67^{a}	11.44^{a}	13.00^{a}	11.78^{a}	12.47	0.072
Nomber of fruits	15.78^{a}	8.44^{b}	16.67^{a}	11.00^{ab}	12.97	0.022
Fruits weight (g)	4.00^{ab}	1.78^{b}	5.11^{a}	2.44^{b}	3.33	0.004

Values followed by the sameletter in line are not significantlydifferent at the 5% threshold

3-3. Simultaneouseffect of water regime and fertilisers on variation in agro-morphologicalparameters

Table 3 shows the simultaneouseffect of the water regime and the fertilisersapplied on the variation in the agro-morphologicalparameters of the tomato plant. It can beseenthattomato agro-morphologicalparameterswereaffecteddifferently by the combinedeffect of the water regime and fertilisers. More explicitly, no significantdifference ($p > 0.05$) wasobservedbetween the growthparameters (height, branching and span) of tomato plants withfertilisers (organic and mineral) underwateringapplied 7 times a week.On the other hand, the yieldparameters (number of fruits and fruit weight) showedstatisticallysignificant values under the hydricregime of watering 7 times a weekwith the differentfertilisersapplied. With an overallaverage of 17.50 fruits per tomato plant, the NPK treatmentstimulated the highestnumber of fruits (28.33 fruits per plant) comparedwith the organicfertilisers, poultrydroppings-PM (19.00 fruits), sawdust-SD (10.00 fruits) and the white control-CO (12.67 fruits), whichwerestatisticallyidenticalunderthiswateringregime (watering 7 times a week). For fruit weight, the water regimeassociatedwith the differenttreatmentswasalsosignificant ($p < 0.05$) with an overallaverage fruit weight of 4.92 grams. The highest fruit weightwasnotedwith NPK (8.67 g) and the lowestweightswereobservedwithsawdust-SD (2g) and the blank control-CO (3.33g), whilepoultrydroppings gave an intermediate fruit weight value (5.67g) under water sprinkling 7 times a week.Withwatering 4 times a week, fertilisershad no statistical impact ($p > 0.05$) on the agro-morphologicalparameters of the tomato plant, except for plant height, whichshowedsignificant values ($p < 0.05$) with an overallaverage of 29.50 cm. However, itshouldbenotedthat the greatestheightswereobservedwithpoultrydroppings-PM (34.33cm) and the blankcontrol-Te (34.00cm). Sawdust-SD (23.33 cm) and NPK (26.33 cm) gave statisticallyidentical and the lowestheights.As for the wateringregime of 2 watersprinklings per week, all the fertilisingtreatmentssignificantly ($p < 0.05$) affected all the agro-morphologicalparameters of the tomato plant. It can beseenthatpoultrydroppings-PMhad a much more expressive effectwith the highest values whatever the tomatoparameterassessed. This treatmentwasfollowed by NPK, sawdust-SD and the blank control-CO in descendingorder.

4. DISCUSSION

4.1. Water regime and variation in tomato agro-morphologicalparameters

The results of the water regimesapplied to tomatoshowedthatregulardailywatering (7 times/week) had a verysignificanteffect on growth and yieldparameterscomparedwithwatering 4 times/week and 2 times/week in decreasingorder. In otherwords, wateringfrequencyhad a significant impact on tomatogrowth and yieldparameters. This couldbeexplained by the factthatdailywateringincreased the soil's water potential and resulted in a good usefulsoilreserve for the roots[14], which in turnled to harmoniousgrowth and development of the plant'sparameters. This resultcorroborates the work of Hireche[15] on vines, whoshowedthat plant heightincreasedregularlywith water regimes. Similarly, work by Nguinambaye[16] and Falalou[17]showedthatregularwatering of plants increasedgrowthparameters in lentil and cowpea.

Table 3:Simultaneouseffect of water regime and fertilizers on the variation of agro morphologicalparameters

Parameter	Watering 7/Week						Watering 4/Week						Watering 2/Week					
	PM	**SD**	**NPK**	**CO**	***Mean***	***P value***	**PM**	**SD**	**NPK**	**CO**	***Mean***	***P value***	**PM**	**SD**	**NPK**	**CO**	**Mean**	***P value***
Height (cm)	37.33^{a}	28.67^{a}	42.67^{a}	36.00^{a}	36.17	0.087	34.33^{a}	23.33^{b}	26.33^{b}	34.00^{a}	29.50	0.031	34.00^{a}	25.67^{bc}	31.67^{ab}	22.33^{c}	28.42	0.010
Branching	15.67^{a}	11.00^{a}	14.67^{a}	13.33^{a}	13.67	0.150	16.00^{a}	13.67^{a}	11.67^{a}	15.33^{a}	14.17	0.147	15.00^{a}	11.67^{b}	15.00^{a}	9,67^{b}	12.83	0.001
Span (cm)	13.00^{a}	12.67^{a}	13.67^{a}	15.00^{a}	13.58	0.333	14.33^{a}	11.00^{a}	12.33^{a}	11.33^{a}	12.25	0.095	13.67^{a}	10.67^{ab}	13.00^{a}	9.00^{b}	11.58	0.016
Nomberof fruits	19.00^{b}	10.00^{b}	28.33^{a}	12.67^{b}	17.50	0.004	13.00^{a}	10.67^{a}	8.00^{a}	12.67^{a}	11.08	0.323	15.33^{a}	4.67^{b}	13.67^{ab}	7.67^{ab}	10.33	0.031
Fruits weight (g)	5.67^{ab}	2.00^{b}	8.67^{a}	3.33^{b}	4.92	0.007	2.67^{a}	2.33^{a}	3.00^{a}	2.33^{a}	2.58	0.891	3.67^{a}	1.00^{b}	3.67^{a}	1.67^{ab}	2.50	0.010

Values followed by the sameletter in line are not significantlydifferent at the 5% threshold

In conclusion, the low values of growth and yieldparametersobtainedwithirregularwatering (watering 2 times/week and 4 times/week) wouldbe due to water stress. Irregularwateringinducedreductions in water potential and stomatal conductance, causingdisturbances in photosyntheticmetabolism or water stress, whichcreatesphysiologicaldisorders in tomato plants. This wouldexplain the reduction in normal plant growth and evenflower drop [18-19]. INRA [20] has shownthat a water deficitreduces the size of organs, fruiting and the number of seeds, resulting in a drop in yield. Similarresultswereobtained by Chebouti and Abdelguerfi[21], Chebouti et al, [22] and Libbey[23] in plants subjected to water deficitduring the vegetative and flowering phases.

4.2 Fertilisers and variation in tomato agro-morphologicalparameters

The resultsobtainedshowedthat, although the application of fertilisers, bothorganic and mineral, significantlyaffected the agro-morphologicalparameters of the tomato, the highestparameter values wereobtainedwithpoultrymanure (PM), NPK and sawdust in ascendingorder. This can beexplained by the factthatmineralisation of the organicmatter in poultrydroppings (PM) by micro-organismsprovided the tomato plant with the nutrientsitneeded for growthcomparedwithotherfertilisers. Indeed, Mulaji[6] andOjetayo et al, [24]showedthat the rate of decomposition of organicmatter and the growth of crop plants wascloselylinked to the synchronisation between the release of nutrients and theiruptake by the plant. The higher values of growth and yieldparametersobtainedwithpoultrymanure (PM) wouldbe due to the continuousmineralisation and release of nutrients and theiravailability to the plant duringits life cycle. Poultrydroppings are easilydecomposed[25], allowing the absorbent complex to easily fix and release nutrients. In addition, Dean et al [26] showedthat the short- and medium-term application of poultrydroppingsincreased total nitrogen and availablephosphoruslevels in the soil, therebystimulatingtomatogrowth and development. In addition to poultrydroppings, NPK mineralfertilisersinduced high values for the tomato's agro-morphologicalparameters. This result can beexplained by the factthatmineralfertilisers are synthetic substances produced by the chemicalindustrythat are made directlyavailable to the plant for nutrition untilthey are broken down [27]. They have a direct effect on plant growth and development. Numerousstudies, includingthose by Bhardwaj et al. [28] ontomato, Olaniyi et al. [29] on okra, Ojetayo et al.[24] on cabbage and Musas [30] on onion and spinach, have shown good recovery and growth of plants on soilfertilisedwith NPK 15-15-15.The values of the agro-morphologicalparametersrecorded for sawdustwerelower or intermediatethan for the poultrydung-basedorganic fertiliser. Theserelativelylow values for the parametersobservedcouldbeexplained by the slow decomposition and mineralisation of organicmatterfromsawdust. In fact, sawdustisverydifficult for micro-organisms to digest, whichwoulddelay root access to soilnutrientsaccording to the work of Cobo et al. [31]. The sawdustwasunable to decomposenormally to release the mineralelementsrequired for plant growth.

4.3. Water-fertiliser regimes and variation in tomato agro-morphologicalparameters

The combinedeffect of the water and fertilizerregimesshowedthat all the agro-morphologicalparametersweresignificantlyaffected by the irregularwatering condition, more specifically, wateringtwice a week.In addition, poultrymanure (PM) recorded the highest values for all parameterscomparedwith NPK fertiliser, sawdust and the control in descendingorderunder the condition of irregularwateringtwice a week. This resultcouldbeexplained by the factthatwateringtwice a weekcreated normal and optimal conditions for the decomposition of organicmatterintonutrients by decomposers, thusimprovingsoil structure [32-33] and ensuring plant nutrition [34]. The living beings or micro-organisms (fungi, bacteria and insects) present in the soilneedmoisture to live and break down organicmatterefficiently. However, the optimum humidity for the decomposition and mineralisation of organicmatter must besuitable for good microbialactivity. Filemon [35] and Charnay [36] have writtenthat the water content of organicwaste to bedecomposed and mineralised, which conditions the activity of microorganisms, isgenerally 50-60%.According to theseauthors, if the water content fallsbelow 30%, decomposition of the materialisinhibited, and if itexceeds 70%, the water begins to fill the gaps in the organicwaste and preventsoxygen exchange, causinganaerobic conditions that are unfavourable to decomposition. This anaerobic and asphyxiated condition due to excess water and soil saturation inhibits or stops the activity of decomposers, and mineral compounds are immobilised and incorporatedintomicrobialcells. In anoxic conditions, microorganisms use the organicmattertransformedintonutrients in theirbiomass for theirsurvival[37]. This immobilisation of nutrientstemporarilydepletes the soil solution of nutrients, limiting the plant'smineral nutrition [38]. This isreflectedvariably in the insignificant values of organicfertiliserswithdailywatering (7 times/week and 4 times/week).

5. CONCLUSION

The aim of the studycarried out at Yomian-Kouadiokro in the Diabo sub-prefecture of central Côte d'Ivoire was to determine the combinedeffect of the water regime and the use of organicfertilisers in improvingtomatoproductivity in central Côte d'Ivoire. At the end of thiswork, itemergedthat the agromorphologicalparameters of the improved PADMA tomatoweremuch more improvedunderwatering conditions (2 times/week) comparedwithwatering conditions of 7 times/week and 4 times/week, regardless of the treatmentsapplied (organicamendments or fertiliser). However, itshouldbepointed out that the workshowedthatpoultrydroppingsproved to be the best organic fertiliser comparedwithsawdust and NPK fertiliser in the ecosystemstudied.

REFERENCES

[1]-MINAGRI. Agricultural orientation policy in Côte d'Ivoire. Law No. 2015-537 of July 20, 2015 on agricultural orientation. Official Journal of the Republic of Côte D'Ivoire, 2015, 12 p. French.

[2]-PNIA. National Agricultural Investment Program in Côte d'Ivoire. Abidjan, Final Report November 2017, 156 p. French.

[3]-MINADER. Ministry of Agriculture and Rural Development of Côte d'Ivoire. Abidjan, Final Report, 2022, 96 p. French.

[4]-FAO. The State of Food and Agriculture. Furthering the Reduction of Food Losses and Waste. Rome, 2019, 203 p. French.

[5]-Gala Bi T.I., Camara M., Yao-kouame A. &Keli Z.J. Profitability of mineralfertilizers in rainfedrice cultivation on the plateau: the case of the Gagnoa area in the center-west of Côte d'Ivoire. Journal of applied biosciences, 2011, 46: 3153-3162. French.

[6]-Mulaji K.C. Use of householdbiowaste composts to improve the fertility of acidicsoils in the province of Kinshasa (Democratic Republic of Congo). Doctoral thesis, Gembloux Agro bio tech. 2011; 220 p. French.

[8]-Mukalay M.J., Shutcha M.N., Tshomba K.J., Mulowayi K., Kamb C.F., Ngongo L.M. Causes of high plant heterogeneity in a maizefieldunder the pedoclimatic conditions of Lubumbashi. Presses Universitaires de Journal of Animal & Plant Sciences, 2018, 38(3): 6292-6306. French

[9]-Nuhu Y. & Mukhtar F.B. Screening of somecowpeagenotypes for photosensitivity. Bayero Journal of Pure and Applied Sciences, 2013, 6(2): 31 -34.

[10]-Koffi A., Brou L., Kpangni B., Sylla M., Tapé C. & Moustapha. P. In-depthassessment of foodsecurity in rural households in Côte d'Ivoire. World Food Programme, Country Office, Côte d'Ivoire, 2009, 79 p. French.

[11]-N'Kouannesi M. The geneticmorphological and physiologicalevaluation of AfricanCowpeagenotypes. Thesispresented for the degree Magister ScientiaeAgriculturae at the university of the Free State, Bloemfontein, South Africa; 2005.

[12]-Amani M.K., Koffi F.K., Yao B.K., Kouakou B.D., Jean E.P and Sékouba O. Analysis of climatevariability and its influences on seasonalrainfall patterns in West Africa: the case of the N'zi (Bandama) watershed in Côte d'Ivoire. European Journal of Geography, Environment, Nature, landscape, 2010. Accessed 15/11/2022.

https://cybergeo.revues.org/23388, French.

[13]-Kouakou K.J, Yapi A. Alui K.A, Akotto O.F and Yao-kouame A. Soillandscape and distribution of imperatacylindrica (L.) P. Beauv. (Poaceae) in two agro-ecosystems of Côte d'Ivoire: Abidjan and Bouaké, International Journal of Innovation and Scientific Research, 2016, 22(1): 238-249. French.

[14]-Rasmata N, Gérard Z, Zoumbiessé T & Mahamadou S. Effect of water regime on okra yields in off-season cultivation. Sciences & Nature, 2009, 6 (2): 107-116 French.

[15]-Hireche Y.A. Response of alfalfa (Medicago sativa L) to water stress and seedingdepth. Master'sthesis, Al Hady Lakhdar University-Batna (Algeria), 2006, 83 p. French.

[16]-guinambaye M.M. Study of somephysiologicalparameters in lentil 410 under water stress conditions. DEA thesisUniversity of Ouagadougou, 2010, 55p. French.

[17]-Falalou H. Physiologicalresponse of cowpea (VignaunguiculataL.Walp) to water deficitoccurringduringtwo stages of development, earlyflowering and earlypod formation. DEA thesis. University of Ouagadougou, 2000, 62P. French.

[18]-Passioura J.B. Water-use efficiency in farmers' fields. In "Water-Use Efficiency in Plant Biology" (Ed. M Bacon) Blackwell, Oxford, 2004: 302-321.

[19]-Dam J., Nguinambaye M.M, Gueloh F.S. Impact of water stress on the production of a sorghumvariety (Sorghum bicolor [L], S35 in Chad. Journal of Animal & Plant Sciences, 2020, 45 (2): 7870-7883 French.
[20]-NRA. Drought and agriculture:reducing the vulnerability of agriculture to an increasedrisk of water shortage. Synthesis of the collective scientific expertise report, 2006, 76p. French.
[21]-Chebouti A. &Abdelguerfi A. Effect of water stress on the production of pods and seeds in some populations of Medicago truncatula (L) Gaertn, Institut National Agronomique El-Harrach, 16200, Algiers, Algeria, 2000: 237-240. French.
[22]-Chebouti A., Abdelguerfi A. &Mefti M. Effect of water stress on pod and seedyield in threespecies of annualalfalfa: Medicago aculeata, Medicago orbicularis and Medicago truncatula, National Institute of AgronomicResearch of Algeria CRP Baraki, Algiers, Algeria, 2001: 163-166 French.
[23]-Libbey J. Forest dieback in Morocco: analysis of causes and control strategy. Science and global change/drought, 2003,14 (4): 209p French.
[24]-Ojetayo AE, Olaniyi JO, Akanbi WB, Olabiyi TI. Effect of fertilizer types on nutritionalquality of twocabbagevarietiesbefore and afterstorage. Journal of Applied Biosciences. 2011, 48: 3322–3330. [25]-Enujeke, E.C. Effects Of PoultryManure On Growth And Yield Of ImprovedMaize In Asaba Area Of Delta State, Nigeria. IOSR Journal of Agriculture and Veterinary Science, 2013, 4(5): 24-30.
[26]-Dean D.S, Earl C.S, Raymond EK. Irrigation management for corn in the northern Great Plains, USA. Irrigations Sciences, 2000, 19:107-114.
[27]-ANPEA. Fertilizationsector. Reference of good agricultural practices, 2012, 157 p. French.
[28]-Bhardwaj M.L, Raj H, Koul B.L. Yieldresponse and economics of Organics sources and inorganic source in tomato (Lycopersicon esculetum), okra (Hibiscus esculentus), cabbage (Brassicaoleraceae var B. Oleracea var botytis). Indian Journal of Agricultural Science. 2000; 70 (10): 653-656.
[29]-Olaniyi J.O, Akanbi W.B, Olaniran O.A, Ilupeju O.T. Effect of organic, inorganic and organominerals on growth, fruit yield and nutritional composition of okra (Abelmoscusesculentus). Journal of Animal and Plant Sciences, 2010, 9 (1): 11135-1140.
[30]-Musas NN. Agronomicvalorization of bio-waste and soilfertility management in urban and peri-urbanagriculture:Effects of increasing doses of mineralfertilizers, humanfeces and their combination on the production of onion (Allium cepa) and spinach (Spinaciaoleracea). Final year dissertation, Faculty of Agricultural Sciences, Unilu. 2012: 43p French.
[31]-Cobo J.G., Barrios E., Kaas D.C.L. & Thomas R. Nitrogenmineralization and cropuptakefrom surface appliedleaves of green manurespecies on a tropical volcanic –ashsoil. Biology and Fertility of soils, 2002, 36:87-92
[32]-Beauchamp J. Propriétés des sols. University of Picardie Jules Verne, 2003:14 p. French.
[33]-Daujat A., Éveillard P., Hebert J. &Ignazi J-C. « FERTILIZERS », EncyclopædiaUniversalis [online], 2015. Consulted on February 7, 2023. URL:http://www.universalis.fr/encyclopedie/fertilizers/ French.
[34]-CIRAD & GRET. Memento de l'Agronome. French Ministry of ForeignAffairs, 5th ed., JOUVE, ISBN 2-86844-129-7 and 2-87614-522-7, 2002:1691 p. French.
[35]-Filemon A. Solid waste management principles and practices, 2008: 216 p.
[36]-Charnay F. Compostingwaste in developing countries: developing a methodologicalapproach for sustainable compost production. Doctoral thesis, University of Limoges (France), 2005: 448

.