Review Form 1.6

Journal Name:	**Journal of Scientific Research and Reports**
Manuscript Number:	**Ms_JSRR_94067**
Title of the Manuscript:	**Improving The Photosynthetic Efficiency and Productivity of Cowpea in Sub Saharan Africa: A Review Paper**
Type of the Article	**Review Article**

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This journal's peer review policy states that **NO** manuscript should be rejected only on the basis of '**lack of Novelty'**, provided the manuscript is scientifically robust and technically sound.
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PART 1: **Review Comments**

	Reviewer's comment	**Author's comment** *(if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)*
Compulsory REVISION comments	**1. Introduction:** *Energy conversion, which is dictated by photosynthetic efficiency, is a factor? ….major? limiting?? Suggestions to complete the incomplete sentence in crops including rice, wheat, and maize, as well as cowpeas, that contributes to yields below their potential maximum *…. the efficiency of this energy conversion to harvestable biomass ~~is still unknown~~ I don't agree, several studies explain and show the relationship between energy conversion and harvestable biomass, so, I propose delete the fragment of sentence. ***** Despite the fact that some studies have indicated a negative relationship between leaf area ~~photosynthesis~~ and yield, or between leaf area, photosynthesis and yield? * Cowpea (*Vigna unguiculata* L. Walp.) * The seeds of cowpea varieties each varieties?? Approve with reference weigh between 80 and 320 milligrams and are spherical to kidney-shaped ***** It is one of the nutrient-dense African indigenous vegetables with the potential to improve food and nutrition security in Sub-Saharan Africa. This sentence must be integrated in the part in which authors describe the importance of Cowpea as proposed in the main text. **2. Cowpea Production in Sub Saharan Africa** *According to Olayiwola and Soremi, (2014), 52% of Africa's cowpea crop is used for food, 13% for animal feed, 10% for seeds, 9% for other uses, and 16% is wasted. For each reason this important percent of crop is wasted (give a minimum of reasons) ???? **3. Importance of Cowpea** *Mathiot (2020) and Carmo-Silva (2022) cowpeas are grown throughout incomplete idea * Other cowpea varieties have been shown to control the nematode How?? (a brief description to get the reader a simple idea) (Scutellonema cavenessi), a serious pest of various crops in Sub-Saharan Africa (Nderi, 2020) **4. Factors That Limit Photosynthetic Potential in Cowpea** * Photosynthesis efficiency of crops is limited when subjected to stress conditions such as high light intensity, low temperature, low CO_2 environment, and water limitation. Keys (1986) and Fernie and Bauwe, (2020) regarded photosynthesis as a wasteful process in their studies. Because the importance of the document, I propose talk about of other limiting abiotic stress factors such as salinity, heavy metals.… * Little is known about the biochemical processes that determine chlorophyll content chloroplast photosynthetic efficiency or the ability to convert light energy into carbon gain (Ahmad *et al*., 2022) No, I don't agree, these are well studied and published among the literature. Sorry, you need to modify this part of discussion. * Other research (reference?) explains that lowering the Rubisco concentration in crops reduces photosynthetic efficiency. **4.1 Structure of the plant leaf** * **4.1 Structure of the plant leaf** The increase in yield is greatest when the Sun is directly overhead but as the Sun angle decreases, this benefit gradually diminishes. Kumagai *et al*. (2022) and some other studies (add other reference of study or modify other studies by other authors by Gitelson *et al*. (2014) investigated……. * Correlation between leaf Chlorophyll content, leaf optical characteristics, and biochemical capacity in several soybean accessions, as well as a wild type and a Chlorophyll content-deficient mutant, using a variety of criteria was tested (References?). * The key limiting factor for canopy photosynthesis in lower biomass canopies was leaf area, according to Digrado *et al*. (2022); while, the major limiting factor in greater biomass canopies was the light environment rewrite the sentence to be more	

	understanding **4.2 Temperature** * Study by Hall and Rao, (1999) have shown that at low light intensities (Indicate when light intensity is low (Values of measure) ? the rate of photosynthesis is the same at 15 ^{0}C and 25^{0}C (precise the specie or the group of plant (C3,C4..). The reaction in the light limiting region, like true photochemical reaction are not sensitive to temperature. At higher light intensities(Indicate when light intensity is high (Values of measure), however, the rate of photosynthesis is much higher at 25^{0}C than 15^{0}C. Thus, factors other than mere photon absorption influence photosynthesis in light saturation region. Temperature, both at low temperatures (chill stress) and at high temperatures (heating stress), is a potential abiotic stress factor in reducing photosynthetic efficiency, productivity, and yield of planted crops around the world (references). Temperature is an important abiotic factor that affects plant growth and development (Muhammed *et al*., 2021). Abiotic stress, such as high temperatures, reduces the plant's photosynthetic rate (Sharma *et al*., 2020) rewrite these sentences avoiding repetition of idea and vocabularies (Temperature, abiotic stress). The plant's vegetative development characteristics and metabolic activities are also negatively impacted precise the factor. Aside from it, emergence, maturity/ripening, harvesting time (duration/stage), and plant production are all influenced (Prasad *et al*., 2008; Shah *et al*., 2011). Low temperatures (chilling stress) have also been shown to affect plant metabolism and severely effect plant growth and development (Bhattacharya, 2022). Low temperatures (chilling stress) also have an adverse effect on germination, seedling emergence, and plant vigor, resulting in a reduction in plant productivity (Sabagh *et al*., 2020). (At the begning of this paragraph, author talk about chill and heating stress(" Temperature, both at low temperatures (chill stress) and at high temperatures (heating stress)", for this reason it is needed to describe heating stress effects on the different parameters affected by chill stress. **4.4 photorespiration** In warm environments (Temperature? Or indicate region), the rate of photorespiration increases as the temperature rises (reference). The photorespiratory C2 metabolism downstream of RuBisCO can be delayed by removing or down regulating an enzyme in the C2 pathway (Reference). **4.5 CO_2 concentration** * Hall and Rao (1999)there are many recent studies explain more this phenomena * reported that in the light-limiting zone, lowering CO_2 content has no effect on photosynthesis rate (it's obvious, because in the limiting zones all photosynthesis is inhibited and subsequently the amount of co2 has no effect, which implies that CO_2 does not participate directly in the photochemical activity!!!!please be sure * and PPFD (replace the abbreviation by the correct vocabularies and put PPFD between parentheses * The CO_2 concentration outside continues to rise, now reaching 400 parts per million (ppm) – and significantly higher in urban areas (?? Explain more and give reference). * While this rise has severe environmental consequences, it is a key component of photosynthesis, which boosts plant growth in a subtle way. The CO_2 concentration inside a greenhouse, on the other hand, is rarely at 400 ppm. When greenhouses are closed for the winter and loaded with crops, for example, CO_2 is utilized by the plants, and the concentration drops to as low as 200 ppm. Low CO_2 concentration has two repercussions, according to Hudson *et al*. (1992): photosynthesis is reduced and the light saturation point is reduced (The light saturation point is the point at which further increases in light have no effect on photosynthesis). At low CO_2 concentrations, the value of additional lighting is diminished. Photosynthesis increases as CO_2 levels rise until it reaches a saturation point usually around 1,000 ppm. I propose that author rewrite this section and essay to summarize the same ideas in one sentence and give the reference (s)….there are the same results that are repeated in different sentences. * Reorganize all the paragraph **4.5 CO_2 concentration (describe the parameters one by one, if the author finish the discussion of a parameter, he must not repeat the talk about it in another time of the paragraph.)** ***why author do not indicate the name of specie subject of study mentioned (reference)…The are many differences between C3, C4 and CAM plants when we talk about photosynthesis….** **5 Strategies for Improving Photosynthetic Efficiency in Cowpea**	

	***** Delay in senescence has a physiological influence on carbon capture and nutrient transport to growing sinks, and it is thought to be a useful characteristic in conferring abiotic stress tolerance (How? the relationship between the two ideas mentioned , is not claire … * Empirical selection for functional stay-green has been demonstrated in studies (references??) *What author propose for Cowpea? **5.2 Enhancing Photosynthetic Processes by Modifying Photorespiration Metabolism** ***** Several ways (such as,) have been proposed to reduce rates of photorespiratory energy or carbon loss, based on either natural * Recent research suggests (references) that altering photorespiratory fluxes or creating * What author propose for Cowpea? Photorespiration is the principal physiological process that detoxifies 2-phosphoglycolate (2-PG) and is responsible for 20–50% yield loss, depending on the environmental circumstances and the kind of photosynthesis used by the plant species (Hernandez and Nägele, 2022). A "bin" is a genetic map location with a distinct segregation pattern that is separated from neighboring bins by a single recombination event (Abed *et al*., 2022). Between two fixed Core Markers, the genetic maps are partitioned into 100 segments, called bins, of 20 cM each according to (Thakur *et al*., 2021). A bin is the interval between the leftmost or top Core Marker and the following Core Marker that includes all loci. The accuracy with which a locus is assigned to a bin is determined on the precision of mapping data, which improves as the number of markers or populations grows. Bin 1 refers to the beginning of a range, while bin 2 refers to the end of the range, whenever the placement is statistically ambiguous. For one gene, two or more chromosomal numbers or bins may exist. Many gene families and proteins are formed as a result of gene duplication. Duplication may have happened at an evolutionary time point, causing gene sequences to diverge over time, resulting in genes being present in many chromosomal positions (what is the aim of author? Why author give theses descriptions of genetic details??? * **Enhancing Photosynthetic Processes by Modifying Photorespiration Metabolism** is the title of this section, why author furnish genetic data base and details? Author must talk about the precisely strategy suggested . Why author do not precise the plant subject of molecular experiments described? * In this era of synthetic biology, these pathways will provide significant yield advances by providing new chances for enhancing photosynthetic efficiency (Batista-Silva *et al*., 2020). Moore *et al*. (2021) also highlighted a variety of ways for decreasing substrate entrance in the photorespiratory pathway to boost crop yield, such as optimizing metabolite flow and reducing RuBP oxygenation. Optimizing the flux of the toxic metabolite 2-PG to speed up 3-phosphoglycerate recovery could be a potential method for increasing production. However, anatomical changes should be made to ensure that inter-organellar metabolic flux is not restricted by spatial constraints, such as the conversion of glycolate into glycine in the peroxisome and further decarboxylation in the mitochondrial compartment in the photorespiration salvage pathway. Transgenics overexpressing mitochondrial glycine decarboxylase also showed better photosynthesis as a result of increased metabolic flux via photorespiration (Timm and Hagemann, 2020). As indicated by Eisenhut *et al*. (2019), genetic interventions that construct new synthetic bypasses of photorespiration in a single chloroplast compartment will be very useful in enhancing photosynthetic efficiency. Alternative photorespiratory pathways have the potential to boost C3 crop output significantly. Alternative photorespiratory methods have been tried in tobacco, including the E. coli glyoxylate oxidation pathway, glycolate oxidase, and malate dehydrogenase pathways. Without the involvement of mitochondria or peroxisomes, Arabidopsis and potato convert 2-glycolate to glycerate completely in chloroplasts (Bauwe and Fernie, 2021). In tobacco chloroplasts, Naseem *et al.* (2020) assessed the outcomes of these three different photorespiratory (AP) routes. Plant development and carbon fixation were likewise slowed in mutant rice lines with defective Os PLGG1. This was due to the function of PLGG1 in regulating glycolate/glycerate concentrations in chloroplasts to safe levels (South *et al*., 2017). These researches on creating photorespiratory bypass channels by membrane transporter alterations pave the way for greater photosynthetic efficiency	

	and agricultural yield potential (long et al., 2015; Simkin et al., 2019). However, so far, genetic-engineering technology has had only little success in enhancing photosynthetic efficiency (Eisenhut and Weber, 2019). Modification of genes regulatory sequences could be another way to improve photosynthetic efficiency. Fine-tuning gene expression, modifying substrate affinities to improve enzyme catalytic performance, and inducible systems are all innovative ways to manipulate photorespiration in agricultural plants. A promising method for increasing photosynthetic productivity is to reduce photorespiratory loss. Thank you for the large amount of information, but there are no links between ideas I propose rewriting this part to be more understanding **5.4 Manipulation of Rubisco Biogenesis** ***** The enzyme Ribulose 1, 5-bisphosphate carboxylase-oxygenase (RuBisCO) is responsible for the fixation of carbon from atmospheric CO_2 as part of the Calvin-Benson cycle, which leads to the creation of glucose, which is required for most photosynthetic organisms' growth. Despite its critical role in CO_2 fixation in autotrophs like food crops, RuBisCO's moderate catalytic turnover rate and poor oxygenation reactions make it a viable target for improving photosynthetic efficiency These informations are mentioned previously in the beginning of the document why author repeat description?. * in higher plant as a result of it multi nature and regulation by nuclear and chloroplast encoded genes * Rubisco structure-function investigations of higher plant Rubisco have been impeded by the inability to build Rubisco from any photosynthetic eukaryote within Escherichia coli rewrite these sentences without repetition and give reference * Rubisco from Rhodosprillum rubrum allows for the quick transformation of tobacco with changed Rubisco (Li *et al*., 2021). Avoid repetition Another method for improving photosynthetic performance of our food crops is to bioengineer a thermo stable RuBisCO activate (RCA). RCA activates RuBisCO by eliminating sugar-phosphate analogs that are comparable to RuBP. In heated conditions, however, RuBisCO's effectiveness suffers due to its high thermo-sensitivity. In Arabidopsis, replacing native RCA with thermostable RCA has been shown to increase photo synthetic yield in heat-stressed settings repeat redaction of this section in order to be better organized and Claire * ~~Better~~ choice another vocabulary or fragment such as: More efficient RuBisCO with efficient *The catalytic effectiveness of RuBisCO is determined by two key factors: stronger CO_2 specificity and a faster carboxylation turnover rate. Specificity and RuBP carboxylation turnover rate have been found to be inversely related in studies (Parry *et al*., 2003). So, in order to improve RuBisCO catalysis, these two aspects must be prioritized. Higher plants have also been found to have a wide range of RuBisCO catalysis. According to a study on such RuBisCO variants in the Triticeae tribe to increase wheat photosynthesis, such variation in RuBisCO turnover rate and specificity factor can be used for a CO_2-enriched crop (Parry *et al*., 2003). Furthermore, changes in carboxylation efficiency are due to the L-subunit, which contributes directly to catalytic action. Genetic modification of the chloroplast-encoded L-subunit is another viable method for enhancing RuBisCO catalysis and thus photosynthetic efficiency. Important, but not well described **5.5 Accelerating recovery from photoprotection (NPQ)** * Exposure to light in the lack of appropriate photoprotection reduces photosynthetic light usage efficiency, according to Kromdijk and Walter (2022) * This induction mechanism occurs on a second-to-season time frame and is unaffected by changes in gene expression (Reference). ***** Both components of the NPQ system were adjusted by Kromdijk and Walter (2022), who increased the amount of PsbS for pH sensing and the amount of ZEP (indicate the correct vocabularies and put abbreviation between parenthesis) and VDE(	

	indicate the correct vocabularies and put abbreviation between parenthesis) * Under both controlled and field situations, crops evaluated exhibited a 14–20% increase in biomass (Reference). * The effects of overexpression of PsbS (indicate the correct vocabularies and put abbreviation between parenthesis * optimizing crops to improve light absorption and CO_2 assimilation throughout the canopy has been proposed by Digrado *et al*. (2019) as a strategy to increase yield and meet the needs of a growing population by 2050, and root and canopy design must be taken into account. RIPE team have proposed about nine research strategies to increase crop yield. They have, however, looked into a few major photosynthesis manipulation targets to boost crop yield: (I) increasing the activity of RuBisCO, a key photosynthetic enzyme; (ii) increasing the capacity of plant leaves to transport electrons; and (ii) increasing CO_2 movement via the internal layers of the leaf involved in yield formation (Wu *et al*., 2019). Under non-irrigated conditions, the researchers reported yield variations ranging from 1% reduction to 12% increase depending on the combination of photosynthetic targets, crop, and climatic factors such as water availability (Wu *et al*., 2019). (iv) improving genes involved in relaxation of photoprotection and up-regulate the genes that speed up this relaxation, the researcher reported an increase in yield by 14 to 20% after replicated in field conditions (Kromdijk *et al*., 2016). What about Cowpa What authors suggest? **Conclusion** *Accelerating NPQ responses increased photosynthetic efficiency and biomass productivity by 15% in both greenhouse and field environments. In order to boost cowpea output in SSA, a 60 percent increase in photosynthetic conversion efficiency is expected think carefully before keeping this part in the conclusion	
Minor REVISION comments		
Optional/General comments		

PART 2:

	Reviewer's comment	**Author's comment** *(if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)*
Are there ethical issues in this manuscript?	*(If yes, Kindly please write down the ethical issues here in details)*	

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