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Plant Growth and Water Relations Elevated Atmospheric CO2 Effects Review: Implications for Horticulture

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Abstract: *Empirical records give incontestable proof to the global ascent in carbon dioxide (CO_2) focus in the world's air. Plant growth can be empowered by rise of CO_2; photosynthesis increments and monetary yield is regularly improved. The use of more CO_2 can expand plant water utilize productivity and result in less water utilize. Subsequent to inspecting the accessible CO_2 writing, we offer a progression of need focuses for future research, including:1) a need to breed or screen assortments and types of agricultural plants for expanded dry spell resistance;2) determining the measure of carbon sequestered in soil from horticulture creation hones for enhanced soil water-holding limit and to help in moderating anticipated global environmental change;3) determining the commitment of the horticulture business to these anticipated changes through motion of CO_2 and other follow gases (i.e., nitrous oxide from fertilizer application and methane under anaerobic conditions) to the air; and4) determining how CO_2-actuated changes in plant growth and water relations will affect the mind boggling co operations with bothers (weeds, creepy crawlies, and diseases). Such data are required to grow best management methodologies for the horticulture business to adjust to future environmental conditions.*

Key words: - plant growth, water relations, co_2 effects

I.INTRODUCTION

The level of CO_2 in the environment is ascending at an exceptional rate , has expanded from≈ 280 ppm toward the start of the modern revolution9(≈1750) to≈380 ppm today, and is relied upon to twofold preindustrial levels at some point amid this century (Keeling and Whorf, 2001; Neftel et al., 1985). This global ascent can be essentially ascribed to non-renewable energy source consuming furthermore, arrive utilize change related with modern and additionally populace extension (Houghton et al., 1990). This ascent, alongside other follow gases, s broadly thought to be an essential factor driving global environmental change (IPCC, 2007). Beside the civil argument on anthropogenic-driven environmental change, vegetation will be specifically affected and explore has demonstrated that plants react decidedly to hoisted CO_2 (Amthor, 1995). The vast majority of this examination has concentrated on agricultural and woodland species with restricted work on forte crops associatedwith horticulture.Horticulture is a different industry (including numerous private companies) that effects the scene of both provincial and urban situations and has a financial effect of $148 billion every year in the United States (Hall et al., 2005). We will endeavor to examine the impacts of the ascent in atmospheric CO_2 fixation on plant growth and water relations with a concentration toward suggestions for green generation frameworks with proposals for future research zones.

II.PLANT GROWTH

Carbon dioxide connects the climate to the biosphere and is a fundamental substrate for photosynthesis. Hoisted CO_2 empowers photosynthesis prompting expanded carbon (C) take-up and digestion, along these lines expanding plant growth. Be that as it may, because of contrasts in CO_2 use amid

photosynthesis, plants with a C_3 photosynthetic pathway regularly show more prominent growth reaction in respect to those with a C_4 pathway (Amthor, 1995; Amthor and Loomis, 1996; Bowes, 1993; Poorter, 1993; Rogers et al., 1997). The CO_2-concentrating instrument utilized by C4 species confines the reaction to CO_2 advancement (Amthor and Loomis, 1996). For C_3 plants, positive reactions are predominantly credited to focused hindrance of photorespiration by CO_2 and the inward CO_2 convergences of C_3 leaves (at current CO_2 levels) being not exactly the Michaelis-Menton consistent of ribulose bisphosphate carboxylase/oxygenase (Amthor and Loomis, 1996). Albeit expanded photosynthesis under hoisted CO_2 improves growth for most plants, synopses have reliably demonstrated that this expansion differs for plants with a C3 (33% to 40% increment) versus a C4 (10% to 15% increment) photosynthetic pathway (Kimball, 1983; Prior et al., 2003). Given that most horticulture species have a C_3 pathway, it is normal that they will indicate comparable reactions to raised CO_2. Early work (Cummings and Jones, 1918) exhibited that both vegetable and bloom crops profited from above surrounding convergences of CO_2; the two cyclamens and nasturtiums indicated expanded dry weight and more noteworthy blossom yield when presented to raised CO_2. Since this early work, others have demonstrated that elaborate species react emphatically to lifted levels of CO_2 (Davis and Potter, 1983; Gislerød and Nelson, 1989; Mattson and Widmer, 1971; Mortensen, 1987, 1991; Mortensen and Gislerød, 1989; Mortensen and Moe, 1992; Mortensen and Ulsaker, 1985). Actually, expanding the convergence of CO_2 in glasshouses is a monetarily productive technique for improving growth of elaborate and vegetable crops (Mastalerz, 1977; Mortensen, 1987).Notwithstanding empowering photosynthesis and over-the-ground growth, lifted CO_2 can change C parceling/assignment. Expanded C supply from hoisted atmospheric CO_2 can specially incite the appropriation of photosynthate subterranean (Ceulemans and Mousseau, 1994; Lekkerkerk et al., 1990; Prior et al., 1997; Rogers et al., 1994). Inmany cases, the biggest extent of the additional biomass delivered under lifted CO_2 is discovered subterranean (Rogers et al., 1994; Wittwer, 1995), regularly bringing about expanded root-to-shoot proportion (Rogers et al., 1996). This isn't amazing in that plants have a tendency to designate photosynthate to issues expected to obtain the most constraining asset (Chapin et al., 1987); when CO_2 is raised, the most constraining asset moves toward becoming water or supplements.Albeit less concentrated than over-the-ground reaction, plants frequently indicate expanded establishing under CO_2 advancement (Chaudhuri et al., 1986, 1990; Del Castillo et al., 1989; Rogers et al., 1992). Notwithstanding this early work with plants in holders, expanded establishing has additionally been seen in the field utilizing both open-top field chambers (OTC) and free-air CO_2 enhancement frameworks (FACE). Hoisted CO_2 expanded dry weight of root frameworks for both soybean (44%) and sorghum (38%) developing in OTC (Prior et al., 2003). Earlier et al. (1994) additionally discovered increments in cotton fine roots (dry weight and length) under FACE and that these plants had proportionately a greater amount of their foundations designated far from the rowcenter. Moreover, Prior et al. (1995) announced that these FACE cotton plants had bigger taproots and increments in the number and size of horizontal roots. The advancement of more vigorous root frameworks in CO_2-enhanced conditions may take into consideration more prominent starch storage and surmises more prominent investigation of the soil for assets, for example, water and supplements tomeet plant growth needs amid times of pinnacle request, for example, boll improvement and filling.Notwithstanding increments in establishing, colonization of roots with

mycorrhizae (the harmonious relationship of plant roots with parasites) has been appeared to increment under hoisted CO_2 (Norby et al., 1987; O'Neill et al., 1987; Runion et al., 1997). Mycorrhizae increment supplement take-up by their host plants (Abbott and Robson, 1984), give extra water to plants through hyphal expansion in soil (Luxmoore, 1981), and shield roots from pathogenic microorganisms (Marx, 1973). Since agricultural plants are for the most part developed in compartments without asset impediments (i.e., water and supplements), expanded root growth or mycorrhizal colonization may not wind up noticeably basic for survival and growth until in the wake of outplanting into the scene.In any case, because of restricted establishing space, growth in compartments has been appeared to hose the reaction to CO_2 improvement (Arp, 1991). For plants to utilize a larger amount of atmospheric CO_2, they should have ameans of putting away the extra starches created. We have demonstrated that plants with a tuberous or woody root framework have a tendency to react to CO_2 improvement to a more prominent degree than plants with littler or more fibrousn root frameworks (Rogers et al., 1994; Runion et al., 2010). The constrained establishing volume experienced by plants developing in compartments may help clarify the way that expanded growth of green species under hoisted CO_2 is here and there somewhat lower than that by and large watched for other C_3 plants, falling in the scope of 15% to 25% (Mortensen, 1991, 1994). In any case, the expanded biomass creation under high CO_2 ought to be favorable for agricultural plants in that they ought to accomplish an attractive size all the more quickly.

III. PLANT WATER RELATIONS

Notwithstanding the impacts of CO_2 on photosynthesis and C portion said, lifted CO_2 can affect growth through enhanced plant water relations (Rogers and Dahlman, 1993). Truth be told, most plants (both C_3 and C_4 species) display enhanced plant water relations. Raised CO_2 moderates transpiration by initiating the incomplete conclusion of leaf stomatal watch cells (Jones and Mansfield, 1970). Concentrates in growth chambers and glasshouses have demonstrated that lifted CO_2 decreases transpiration for both C_3 (Allen et al., 1994; Jones et al., 1984, 1985; Pallas, 1965; Prior et al., 1991; Valle et al., 1985) and C_4 (Chaudhuri et al., 1986; Pallas, 1965; Van Bavel, 1974) plants. Dugas et al. (1997), utilizing stem stream measures under genuine field conditions, additionally demonstrated that entire plant transpiration was decreased under raised CO_2 for both a soybean (C_3) and a sorghum (C_4) crop.This diminishment in transpiration, combined with expanded photosynthesis, can contribute to expanded water utilize productivity (WUE = the proportion of carbon settled to water unfolded), which has frequently been accounted for (Baker et al., 1990; Morison, 1985; Sionit et al., 1984). In reality, Kimball and Idso (1983) refered to 46 perceptions that in total demonstrated that transpiration would be brought down by a normal of 34%, which, combined with a financial yield upgrade of 33% (more than 500 perceptions), recommended a multiplying of WUE for a multiplying of CO_2 level. Froma physiological outlook, increasedWUE may speak to a standout amongst the most noteworthy plant reactions to hoisted CO2 (Rogers et al., 1994).Plants with a C_4 photosynthetic pathway demonstrate a littler reaction to lifted CO_2 than plants with a C_3 pathway. Be that as it may, both C_3 and C_4 plants demonstrate diminished transpiration under hoisted CO_2. Subsequently, WUE ought to be fundamentally controlled by transpiration in C_4 plants,whereas both are vital in C_3 plants. This was shown by Acock and Allen (1985) utilizing data from Valle et al. (1985) and Wong (1980). In a later long haul field ponder, comparable estimations indicated commitments of 74% and 26% (for photosynthesis and transpiration,

individually) in soybean comparedwith separate commitments of 42%and 58%in sorghum (Prior et al., 2010a). In spite of the fact that photosynthesis still overwhelmed WUE increment in C_3 soybean, relative commitments of the two procedures were more comparable for C4 sorghum than that detailed by Acock and Allen (1985).Given the way that lifted CO_2 can lessen transpiration, it has been proposed this may halfway improve the impacts of dry season (Bazzaz, 1990) and enable plants to keep up expanded photosynthesis. This has as often as possible been watched (Acock and Allen, 1985; Gifford, 1979; Goudriaan and Bijlsma, 1987; Nijs et al., 1989; Rogers et al., 1984; Sionit et al., 1981; Wong, 1980); in any case, it ought to be noticed that quite a bit of this work was led in growth chambers and glasshouses utilizing plants developing in compartments. Working with compartment developed soybean in field OTC, Prior et al. (1991) announced that, at lifted levels of CO_2, xylem weight capability of water-focused on plants was proportional to that of sufficiently watered plants, demonstrating enhancement of dry spell pressure.It has been recommended that in more indigenous habitats, albeit quick WUE is expanded, entire plant water utilize might be differentially influenced because of expanded plant measure. Allen (1994) detailed that bigger lant measure [higher leaf region file (LAI)] counteracted lessening in water utilize, counterbalancing improved WUE. Jones et al. (1985) demonstrated that, albeit lifted CO_2 expanded WUE for plants with both a high and a low LAI, this expansion was more noteworthy for plants with a lower LAI.Working with longleaf pine developing in vast (45 L) compartments, we found that nitrogen (N) availabilitywas likewise a critical factor influencing the cooperation of WUE and plant water pressure (Runion et al., 1999). Longleaf pine seedlings developed with satisfactory N developed bigger under raised CO2, bringing about expanded entire plant water utilize and expanded water worry in spite of expanded WUE. Seedlings developed with constrained N did not show a growth reaction to raised CO_2, so the increasedWUEresulted in decreasedwhole-plant water utilize and diminished pressure.Notwithstanding enhanced plant water relations, hoisted CO_2 can likewise influence water development through the scene. Water penetration can be expanded and dregs misfortune through spillover can be diminished in high CO_2 conditions (Prior et al., 2010b). These upgrades can come about because of expanded plant establishing (as noted beforehand) and from changes n soil physical properties. Raised CO_2 can expand soil C, total strength, and water driven conductivity and lessening soil mass thickness (Prior et al., 2004). These upgrades in soil/water relations will be especially vital for green plants in the scene.Water is likewise a vital asset in numerous green creation offices and its protection is turning into an undeniably vital issue. The way that lifted CO_2 can increment plant WUE (Rogers et al., 1994) may demonstrate that plants could be watered less every now and again as CO_2 levels keep on rising. Be that as it may, on the grounds that these plants are for the most part developed with ideal supplements, lifted CO_2 may build plant size to a point where watering recurrence should be kept up at current levels or even expanded. This collaboration of lifted CO_2 and asset accessibility will likewise be of basic significance for agricultural species in the wake of outplanting to the scene where occasional dry spells could be moderately visit. The scene's reaction may not be sufficiently reflected by investigations of little quantities of plants developed in compartments; clearly, more work is required inside this imperative industry to boost plant growth, wellbeing, and proficient utilization of assets.

IV.PRIORITY TARGETS FOR FUTURE RESEARCH

Albeit much is known with respect to the impacts of raised CO_2 on plants, plant species have receivedmuch less consideration than agronomic and woodland species. In spite of the fact that it is likely that most plant species will profit (through expanded growth) from rising CO_2, research to help this dispute is deficient. Horticulture contains differing species as far as growth shapes (e.g., annuals, perennials, trees, bushes, forbs, grasses, vegetables, gardening crops, C_3, C_4) and the conditions in which they are developed (e.g., holder versus inground, indoor versus open air). Information of how these assorted plant writes will react to hoisted CO_2 under current developing conditions would be profitable as far as adjusting management systems to future environmental conditions. For instance, in spite of the fact that holder developed plants are known to react decidedly to lifted CO_2 as far as expanded growth, it is additionally realized that root confinement can hose this CO_2 reaction; in this manner, it is vital to decide ideal compartment sizes for delivering attractive plants on auspicious timetables.As noted beforehand, positive growth reactions to raised CO_2 result not just from expanded take-up and absorption of CO_2, yet in addition from diminished transpiration, which enhances plant water relations and WUE. Water preservation is a basic issue for crop creation, especially in specific locales of the United States. Inside the horticulture business, acclimations to watering recurrence may turn into a significant management decision.Knowledge of the impacts of rising CO_2 on entire plant water utilize will help chiefs in upgrading water system calendars and sums.Notwithstanding understanding the impacts of rising CO_2 on water utilization of at present developed green species, it is essential for the business to breed or screen for assortments and species with higher degrees of dry season resistance. It will likewise be essential that these endeavors be directed at present and future levels of atmospheric CO_2 to choose plants that show substantial reactions to lifted levels of CO_2. One anticipated result of global environmental change is modifications in precipitation designs with more outrageous climate occasions, including dry spells (IPCC, 2007). It is significant to the business that plants get by subsequent to outplanting in private what's more, business scene conditions.One methods for enhancing survivability is through utilization of mulch to moderate soil water. In an agronomic setting, cover crops utilized as a part of no-culturing management frameworks can go about as mulch (Balkcom et al., 2007).We have demonstrated that these cover crops increment soil C (Prior et al., 2005) and help in the change of soil physical properties (Prior et al., 2004), which likewise enhances soil water relations (Prior et al., 2010b). Mulch (generally pine bark, pine straw, orwood contributes the southeastern United States) contains high groupings of plant natural C and, when utilized as a part of scene settings, can add to soil C sequestration However, the degree of this commitment isn't as of now known, locally, provincially, or broadly. Besides, contingent upon the destiny of thesematerials (e.g., left nearby, consumed nearby, or utilized as a fuel source at timberland items processes), the potential net increment in soil C from utilizing these materials in scene settings is additionally to a great extent obscure.Notwithstanding mulch, the horticulture business adds to soil C content through internment of compartment media at the season of outplanting. In compartment developed plant generation of nursery crops, plants are developed in a dominatingly pine bark-based substrate. Pine bark is made totally out of natural C, having a C content more prominent than 60% (Simmons and Derr, 2007). At the point when these plants are outplanted to the scene, this speaks to an extensive
measure of C perhaps being sequestered in soil. Carbon can likewise be sequestered in

plant biomass through positive growth reactions to rising CO_2. Be that as it may, to date, little is known concerning the C sequestration capability of the horticulture business all in all; this is basic to evaluate its potential commitment to moderating potential environmental change.The C sequestration capability of the horticulture business will be influenced by the C:N proportion of contributions from biomass, mulch, and compartment media. The C:N proportion of these data sources can be high, recommending moderate disintegration and, along these lines, moderate arrival of CO_2 back tothe air, helping alleviation of global environmental change. At show, the measure of C added to soil through outplanting containergrown agricultural plants is to a great extent obscure. There is additionally little information of the habitation time of thesematerials in soil and of the rate of soil CO_2 motion back to the climate. This information will be pivotal to determining the C sequestration capability of the horticulture business and its commitment to potential global environmental change through transition of CO_2 from soil to air.There is additionally little data on the motion of other follow gases (nitrous oxide and methane) in these frameworks. Horticulture creation offices frequently utilize a lot of water in water system and in addition a lot of fertilizers; this combination of assets could result in considerable transitions of different gases. Like with CO_2 transition, this data is basic to determining the business' potential commitment to environmental change. It is likewise important to grow best management techniques that limit follow gas motion, boost asset utilize effectiveness, and advance growth and financial pick up.Another to a great extent obscure yet essential thought of rising CO_2 will be management of nuisances (weeds, creepy crawlies, and diseases) in these frameworks. Weeds regularly indicate more prominent growth reactions to hoisted CO_2 than do crop plants, which might be the consequence of weeds having more noteworthy hereditary diversity and physiological versatility than oversaw plants (Ziska and Runion, 2007). How rising CO_2 will affect weed management techniques in green frameworks is obscure. The collaborations of plants with the two creepy crawlies and diseases are intricate and fluctuate as per the host– bother arrangement of intrigue; in any case, these cooperations have gotten almost no consideration (Ziska and Runion, 2007).More learning here is required to create bestmanagement procedures to manage these conceivably genuine dangers to efficiency and benefit in horticulture, as well as for agriculture and ranger service too.

CONCLUSION

All in all, lifted CO_2 expands plant growth (both above-and subterranean) and enhances plant water relations (lessens transpiration and builds WUE). It is likely these advantages will likewise happen for green plants, however data to help this are inadequate with regards to in respect to crop and timberland species. Notwithstanding fundamental research on the reaction of assorted green species to future levels of atmospheric CO_2, it might wind up plainly significant to breed or screen assortments and types of plant plants for expanded dry spell resilience because of anticipated changes in precipitation designs. It is additionally vital to decide the measure of C sequestered in soil from horticulture generation rehearses not just for development of soil water-holding limit yet in addition to help in moderation of anticipated global environmental change. Moreover, determining the commitment of the horticulture business to these anticipated changes through transition of CO_2 and other follow gases (through water system and treatment) is of basic significance. How CO_2-actuated changes in plant growth and water relations will affect the perplexing communications with bothers (weeds, bugs, and diseases) is a lacking region of research

for horticulture, as well as for plants as a rule. This data is expected to grow best management systems for the horticulture business to effectively adjust to future environmental change.

REFERENCES

[1] Abbott,L.K. what's more, A.D. Robson. 1984. The impact of VA mycorrhizae on plant growth, p. 113– 130. In: Powell, C.L. what's more, D.J. Bagyaraj (eds.). VA mycorrhiza. CRC Press, Boca Raton, FL. Acock, B. what's more, L.H. Allen, Jr. 1985. Crop reactions to hoisted carbon dioxide concentrations, p. 317– 346. In: Strain, B.R. furthermore, J.D. Cure (eds.). Coordinate impacts of increasing carbon dioxide on vegetation. DOE/ER-0238, Office of Energy Research, U.S. Dept. of Energy, Washington DC.

[2] Allen, L.H. 1994. Carbon dioxide increment: Direct effect on crops and circuitous impacts mediated through expected climatic changes, p. 425– 459. In: Boote, K.J., T.R. Sinclair, and J.M. Bennett (eds.). Physiology and assurance of crop yield. ASA, CSSA, SSSA, Madison, WI.

[3] Allen L.H., Jr., R.R. Valle, J.W. Mishoe, and J.W. Jones. 1994. Soybean leaf gas-exchange responses to carbon dioxide and water stress. Agron. J. 86: 625–636.

[4] Amthor, J.S. 1995. Terrestrial higher-plant response to increasing atmospheric [CO2] in relation to the global carbon cycle. Glob. Change Biol. 1: 243–274.

[5] Amthor, J.S. and R.S. Loomis. 1996. Integrating knowledge of crop responses to elevated CO2 and temperature with mechanistic simulation models: Model components and research needs, p. 317–346. In: Koch, G.W. and H.A. Mooney (eds.). Carbon dioxide and terrestrial ecosystems. Academic Press, San Diego, CA.

[6] Arp, W.J. 1991. Effects of source-sink relations on photosynthetic acclimation to elevated CO2. Plant Cell Environ. 4:869–875.

[7] Baker, J.T., L.H. Allen, Jr., K.J. Boote, P. Jones, and J.W. Jones. 1990. Rice photosynthesis and evapotranspiration in subambient. ambient, and superambient carbon dioxide concentrations. Agron. J. 82:834–840.

[8] Balkcom, K., H. Schomberg, W. Reeves, A. Clark, L. Baumhardt, H. Collins, J. Delgado, S. Duiker, T. Kaspar, and J. Mitchell. 2007. Managing cover crops in conservation tillage systems, p. 44–61. In: Clark,A. (ed.).Managing cover crops profitably. 3rd Ed. Sustainable Agriculture Network, Beltsville, MD.Bazzaz, F.A. 1990. The response of natural ecosystems to the rising global CO2 levels. Annu.Rev. Ecol. Syst. 21:167–196.

[9] Bowes, G. 1993. Facing the inevitable: Plants and increasing atmospheric CO2. Annu. Rev. Plant Physiol. Plant Mol. Biol. 44:309–332.

[10] Ceulemans, R. and M. Mousseau. 1994. Effects of elevated atmospheric CO2 on woody plants. New Phytol. 127:425–446.

[11] Chapin, F.S., III, A.J. Bloom, C.B. Field, and R.H. Waring. 1987. Plant responses to multiple environmental factors. Bioscience 37:49–55.

[12] Chaudhuri, U.N., R.B. Burnett, M.B. Kirkham, and E.T. Kanemasu. 1986. Effect of carbon dioxide on sorghum yield, root growth, and water use. Agr. For. Meteorol. 37:109– 122.

[13] Chaudhuri, U.N., M.B. Kirkham, and E.T. Kanemasu. 1990. Root growth of winter wheat under elevated carbon dioxide and drought. Crop Sci. 30:853–857.

[14] Cummings, M.B. and C.H. Jones. 1918. The aerialbfertilization of plants with carbon dioxid. Vt. Agr. Expt. Sta. Bull. 211.

[15] Davis, T.D. and J.R. Potter. 1983. High CO2 applied to cuttings: Effects on rooting and subsequent growth in ornamental species. HortScience 18: 194–196.
[16] Del Castillo, D., B. Acock, V.R. Reddy, and M.C. Acock. 1989. Elongation and branching of roots on soybean plants in a carbon dioxideenriched aerial environment. Agron. J. 81: 692–695.
[17] Dugas, W.A., S.A. Prior, and H.H. Rogers. 1997. Transpiration from sorghum and soybean growing under ambient and elevated CO_2 concentrations. Agr. For. Meteorol. 83:37– 48.
[18] Gifford, R.M. 1979. Growth and yield of CO_2- enriched wheat under water-limited conditions. Aust. J. Plant Physiol. 6:367–378.
[19] Gislerød, H.R. and P.V. Nelson. 1989. The interaction of relative air humidity and carbon dioxide enrichment in the growth of Chrysanthemum morifolium Ramat. Sci. Hort. 38:305–313.
[20] Goudriaan, J. and R.J. Bijlsma. 1987. Effect of CO_2 enrichment on growth of faba beans at two levels of water supply. Neth. J. Agr. Sci. 35:189–191.
[21] Hall, C.R., A.W. Hodges, and J.J. Haydu. 2005. Economic impacts of the green industry in the U.S. 22 July 2010. <http://hbin.tamu.edu/ greenimpact.html>.
[22] Houghton, J.T., G.J. Jenkins, and J.J. Ephraums. 1990. Climate change: The IPCC scientific assessment. Cambridge University Press, Cambridge, UK.
[23] IPCC. 2007. Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.
[24] Jones, P., L.H. Allen, Jr., J.W. Jones, K.J. Boote, and W.J. Campbell. 1984. Soybean canopy growth, photosynthesis, and transpiration responses to whole-season carbon dioxide enrichment. Agron. J. 76:633–637.
[25] Jones, P., L.H. Allen, Jr., J.W. Jones, and R. Valle. 1985. Photosynthesis and transpiration responses of soybean canopies to short- and long-term CO_2 treatments. Agron. J. 77:119–126.
[26] Jones, R.J. and T.A. Mansfield. 1970. Increases in the diffusion resistances of leaves in a carbon dioxide-enriched atmosphere. J. Expt. Bot. 21: 951–958.
[27] Keeling, C.D. and T.P. Whorf. 2001. Atmospheric CO_2 records from sites in the SIO air sampling network, p. 14–21. In: Trends: A compendium of data on global change. Carbon Dioxide Information nalysis Center, Oak Ridge National Laboratory, U.S. Dept. Energy, Oak Ridge, TN.
[28] Kimball, B.A. 1983. Carbon dioxide and agricultural yield: An assemblage and analysis of 770 prior observation. USDA/ARS Water Conservation Laboratory Report Number 14. Phoenix, AZ.
[29] Kimball, B.A. and S.B. Idso. 1983. Increasing atmospheric CO2: Effects on crop yield, water use, and climate. Agr. Water Manage. 7:55–72.
[30] Lekkerkerk, L.J.A., S.C. van de Geijn, and J.A. van Veen. 1990. Effects of elevated atmospheric CO_2-levels on the carbon economy of a soil planted with wheat, p. 423 429. In: Bouwman, A.F. (ed.). Soils and the greenhouse effect. John Wiley & Sons, New York, NY.
[31] Luxmoore, R.J. 1981. CO2 and phytomass. Bioscience 31:626.
[32] Marx, D.H. 1973. Mycorrhizae and feeder root diseases, p. 351–382. In: Marks, G.C. and T.T. Kozlowski (eds.). Ectomycorrhizas: Their ecology and physiology. Academic Press, New York, NY. Mastalerz, C.D. 1977. The greenhouse environment. John Wiley & Sons, New York, NY.
[33] Mattson, R.H. and R.E. Widmer. 1971. Year round effects of carbon dioxide

supplemented atmospheres on greenhouse rose (Rosa hybrida) production. J. Amer. Soc. Hort. Sci. 96:487–488.
[34] Morison, J.I.L. 1985. Sensitivity of stomata and water use efficiency to high CO2. Plant Cell Environ. 8:467–474. Mortensen, L.M. 1987. Review: CO2 enrichment in greenhouses. Crop responses. Sci. Hort. 33:1–25.
[35] Mortensen, L.M. 1991. Effects of temperature, light and CO2 level on growth and flowering of miniature roses. Nor. J. Agr. Sci. 5:295–300.
[36] Mortensen, L.M. 1994. Effects of elevated CO_2 concentration on growth and yield of eight vegetable species in a cool climate. Sci. Hort. 58:177–185.
[37] Mortensen, L.M. and H.R. Gislerød. 1989. Effect of CO_2, air humidity, and nutrient solution concentration on growth and transpiration of Begonia · hiemalis Fotsch. Gartenbauwissenschaft 54:184–189.
[38] Mortensen, L.M. and R. Moe. 1992. Effects of CO_2 enrichment and different day/night temperature combinations on growth and flowering of Rosa L. and Kalanchoe blossfeldiana v. Poelln. Sci. Hort. 51:145–153.

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