Physiological studies on banana plant

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The present investigation was conducted during 2000/01 and 2001/02 experimental seasons. Fourth and fifth Maghrabi banana ratoons grown in clay loamy soil at Horticultural Research Station of El—Khairia Barrage were the plant material used in this study. Mats/ plantation holes were 3.5 x 3.5 meters apart with 3 reproductive suckers left annually for the orchard successive cropping.It was hoped to investigate the efficiency of some cheap and safe N-K fertilizers sources viz Rhizobacterin, Baker,' yeast and liquid potassium 36% when applied additionally in order to meet the higher quantities of both nutrient elements required by banana plant. So the following four field experiments were included.V. 1. Experiment, I:In this experiment Rhizobacterin (N-biofertilizer) as an additional N. application combined with three levels of N-mineral fertilization, beside control (the adopted N mineral fertilization in the region alone) were investigated. So the N- treatments included were:1-Control (500 g N / plant).2-Rhizobacterin + 500 g N / plant.3-Rhizobacterin + 400 g N / plant.4-Rhizobacterin + 300 g N / plant. _The corresponding quantity of N mineral source / (NH4), SO4 was fractionated into equal doses applied at 15 days interval (from mid March till early October); while Rhizobacterin was added once a year in March at the rate of one liter of newly prepared diluted solution per plant.SUMMARY AND CONCLUSIONV. H. Experiment, II:Baker,' yeast as an additional bio-N fertilizer at 50 & 100 g / plant in combination with two levels of mineral N fertilizer [(NH4)2 SO4 at either 300 or 500 g actual N/plant] and the adopted mineral N fertilizer in the region (500 g N / plant) as control were investigated. Mineral N fertilizer was applied as previously mentioned in experiment, while suspended Baker,' yeast was soil drench applied by dividing the corresponding amount (50 or 100 g / plant) into four equal doses periodically added at one month interval (from July till October).Thus, the investigated treatments in this experiment were as fallows:1-Adopted mineral N fertilization in the region as control [500 g actual N in the form of (NH4)2 SO4].2-500 g actual N as (NI-14)2 SO4 + 100 g Baker,' yeast / plant.3-500g actual N as (NH4)2 SO4 + 50 g Baker,' yeast / plant.4-300 g actual N as (NH4)2 SO4 + 100 g Baker,' yeast / plant.5-300 g actual N as (NH4)2 SO4 + 50 g Baker? yeast / plant.V. III. Experiment, III:In this experiment, four combinations between two rates of both mineral and bio—K fertilizers (K,SO4 & Baker,' yeast), beside mineral K fertilization alone (at the adopted rate in the region) as control were investigated. So the differential treatments were as fallows:1-Adopted mineral K fertilization in the region as control (300 g actual K, 0 in the form of K2 SO4).2-300 g actual K, 0 as K2 SO4 + 100 g Baker,' yeast / plant.3-300 g actual K2 0 as K2 SO4 + 50 g Baker,' yeast / plant.4-150 g actual K, 0 as K2 SO4 + 100 g Baker,' yeast / plant.-198SUMMARY AND CONCLUSION5-150 g actual K2 0 as K2 SO4 + 50 g Baker,' yeast / plant.Taking into consideration that mineral K fertilizer corresponding to every treatment was divided into two equal doses soil added in April & June. While Baker,' yeast was drench applied as previously discussed in the 2"d experiment.V. IV. Experiment, IV:In this experiment four K fertilization treatments (each at the rate of 300 g actual K2 0) were included to investigate the effect of K source; method and number of applicable doses.Thus, the differential investigated treatments per plant were as fal lows:1-Control (300 g actual K2 0 as K2 SO4) fractionated into 2 equal doses soil applied in April & June.2-300 g actual K2 0 in the form of K2 SO4 fractionated into four equal doses soil applied in Apr. ; Jun.; Aug. and Oct.3-225 g actual K2 0 as K2 SO4 fractionated into 3 equal doses soil added in Apr.; Jun. and Aug. + foliar spray with potassium 36* % once in October at the rate of 75 g actual K2 0.4-150 g actual K2 0 as K2 SO4 fractionated into 2 equal doses soil added in Apr. and Aug. + foliar spray with potassium 36* % twice

in June and October at the rate of 75 g actual K2 0 per each.Experimental layout:The complete randomized block design with 3 replications was employed in the conducted four experiments. Three stools / mats (with 3* commercial K foliar fertilizer.ratoons / plants per each) were devoted for every replicate. The influence of the differential treatments included in the aforesaid 4 experiments were investigated through the response of the following measurements:1-Vegetative growth:At the emergence of the inflorescence, pseudostem (height & circumference); number of green leaves / plant; number of produced suckers / plant and average leaf area (3 rd full sized one from the top) were determined.2-Nutritional status (leaf mineral composition): Leaf N ; P; K; Fe; Mn; Zn and Cu were determined.3-Phenological phases:Some phenological measurements i.e., duration from emergence of sucker till inflorescence shooting phase and days from inflorescence emergence (shooting) until harvesting stage were determined.4-Cropping (productivity) measurements:Average bunch weight (Kg.); N° of hands and fingers per bunch, as well as bunch length were determined.5-Fruit quality:In this regard length; diameter; circumference; pedicel length, peel weight, pulp % of finger and peel thickness, besides dry matter%. in pulp was determined as fruit physical properties. Moreover, pulp TSS; acidity; TSS/ acid ratio; starch; total sugars; N; P and K contents were determined as chemical characteristic.SUMMARY AND CONCLUSION Obtained data could be summarized as follows:V. I. Effect of Rhizobacterin as an additional bio—N fertilizer ”experiment, 1”:Rhizobacterin (bio-N fertilizer) combined with (NH4)2 SO4 as mineral N form at 3 levels (500; 400 and 300g actual N / plant) besides the adopted N fertilization rate in the region (500 g actual N) as control were investigated regarding their influence on the following measurements:V. I. 1. Effect on vegetative growth:Data obtained during both seasons revealed that the response of five growth measurements pseudostem (height & circumference); N° of green healthy leaves presented at bunch shooting ; average leaf area and number of arisen suckers per individual ratoon along its whole life to the investing Rhizobacterin x (NH4)2 SO4 combinations, followed generally the same trend .Hence, Rhizobacterin combined with either the highest or intermediate mineral N fertilizer (500 or 400 g actual N / plant) surpassed two other N treatments i.e., control (500 g actual N / plant alone) and (Rhizobacterin + the lower mineral N rate at 300 g actual N / plant). Such trend was true during both seasons, whereas the superiority of both combinations of Rhizobacterin plus either 500 or 400 g actual N / plant over two other N treatments (control & Rhizobacterin + 300 g N / plant) was significant except with N° of green leaves / plant which seemed to be less pronounced and didn’t reach level of significance. Moreover, no significant differences could be observed as both treatments (pairs) of each category (superior & inferior) were separately compared each other for all growth parameters.V. I. 2. Effect on some phenological measurements:Data obtained displayed that both phenological stages (durations from sucker emergence till bunch shooting & from bunch shooting till harvesting) didn’t equally respond to various bio-mineral N fertilization treatments. Since, inflorescence emergence of treated Maghrabi banana plants with Rhizobacterin combined to (NH4)2 SO4 at either 500 or 400 g actual N / plant took place rapidly than control with about 3 or 2 weeks, respectively as an average of two seasons was concerned. However the duration required from bunch shooting till its harvesting didn’t significantly respond to different N- treatments.V. I. 3. Effect on leaf mineral contents (nutritional status):Referring the leaf N; P; K; Fe; Mn; Zn and Cu contents in response to the differential Rhizobacterin x (N144),SO4 combinations, data obtained displayed that most nutrient elements. (P; K; Fe; Mn and Zn) showed no considerable effect, whereas differences in their levels were so slight and didn’t reach level of significance. However, both nitrogen and copper showed a noticeable response, whereas both combinations of Rhizobacterin with either higher (500) or intermediate (400) g actual N per plant resulted significantly in increasing both nutrient elements over control (500 g N / plant with no Rhizobacterin) and (Rhizobacterin + 300 g N / plant).V. I. 4. Effect on some yield (productivity) measurements:In this regard average bunch weight; number of both hands & fingers per bunch and average bunch length were investigated as productivity parameters. Data obtained during both seasons, pointed out that both weight and length of bunch responded obviously, while two-202SUMMARY AND CONCLUSIONother parameters (N° of hands & fingers / bunch) didn’t influence. Herein, the Rhizobacterin treated Maghrabi plants in combination with (NH4)2SO4 at either 500 or 400 g actual per each (especially higher rate) induced significantly the heaviest and tallest bunch. Taking into

consideration that Rhizobacterin + the least mineral N rate (300g actual N) didn't significantly vary than control (500 g mineral N alone).V. I . 5. Effect on fruit quality:V. I. 5. 1. Fruit physical properties:Some measurements dealing with either dimensions / linear (length; diameter; circumference of finger; peel thickness and pedicel length) or weight (fresh weight of finger; pulp, peel and pulp dry matter%) were the investigated fruit physical properties. Data obtained revealed that Maghrabi plants received the Rhizobacterin combined with (NH4)2SO4 at either the highest (500 g) or the intermediate (400 g) actual N rate per plant induced fruits had higher values for all the aforesaid physical properties as compared to the control (500 g mineral N alone /plant). However, the response varied from one character to another. Anyhow, the increase was more pronounced with finger circumference; peel thickness; finger weight; pulp and peel weights, whereas it was significant. On the contrary, the least rate of increase was observed with finger pedicel length; pulp % and pulp dry matter %. Meanwhile, the response of both finger length and diameter was intermediate as compared to the abovementioned two extremes of the more and less pronounced rates of change.V. I. 5. 2. Fruit chemical properties:In this regard pulp TSS %; Acidity % ; TSS / acid ratio; starch %; total sugars %; N %; P % and K % of Maghrabi ripe fruits in response to different bio—mineral N fertilization treatments were the concerned fruit chemical properties. Data obtained during both seasons displayed that the rate of response for each chemical constituent was so slight to be taken into consideration.V. II. Second experiment, effect of Baker,s yeast as an additional bio-N fertilizer:In this regard combinations between Baker,' yeast (100 & 50 g / plant) and (NH4)2SO4 (500 & 300 g N / plant), beside control (500 g actual mineral N only) were investigated.V. II . 1. Effect on vegetative growth:Data obtained during both seasons displayed that both treatments which representing combinations between higher mineral N fertilizer rate (500 g N/ plant) and Baker,' yeast at either 100 or 50 g / plant were generally the most effective. However, the increase was more pronounced and significant for both number of green healthy leaves at bunch shooting and average leaf area. Meanwhile, the increase exhibited by such superior treatments didn't reach level of significance with other vegetative growth parameters i.e., pseudostem height & circumference, and number of arisen suckers per plant. Moreover, 500 g actual N + Baker,' yeast at 50 g per plant ranked second while 3 other treatments i.e., control (500 g actual mineral N only) and both treatments of 300 g actual N combined with Baker,' yeast at either 100 or 500 g / plant had equally similar effect and didn't significantly vary as compared each other during both reasons.Accordingly, it could be safely concluded that Baker,' yeast application was so valuable to replace a considerable share of mineral N fertilizers that finally will be reflected usefully on the Maghrabi banana growers from the economic point of view.V. H. 2. Effect on phenological measurements:Data obtained during both seasons showed that both investigated phenological measurements i.e., duration from suckers emergence till bunch shooting and that from bunch shooting to harvesting (maturation) respond obviously to the five N treatments. Herein, both durations were significantly shortened to the least value by the 500 g actual N + Baker,' yeast at 100 g / plant treatment followed by that of 500 g N + 50 g Baker,' yeast / plant whereas both exceeded the three other N treatments. Such trend was true during two seasons for both durations but the rate of reduction was more pronounced for period required from inflorescence occurrence till maturation of fingers.V. II. 3. Effect on nutritional status (leaf mineral content):Regarding the response of leaf N; P; K; Fe; Mn; Zn and cu contents to the differential investigated combinations between Baker,' yeast (applied at 100 & 50 g / plant) and (NH4)2 SO4 (at 500 and 300 actual N / plant), data obtained pointed out that both N and K were markedly influenced. Hence, both combinations of higher (NH4)2 SO4 rate (500g N / plant) with Baker,' yeast at either 100.0 or 50.0 g per plant increased significantly leaf N and K % of Maghrabi banana cv. over the analogous levels exhibited by three other N treatments. However, other mineral contents (P; Fe; Mn; Zn and Cu) showed light differences could be safely neglicted.V. II. 4. Effect on some productivity parameters (yield):Concerning the response of bunch weight; number of hands & fingers per bunch and bunch length to the different N treatments [Baker,' yeast x (NH4)2 SO4] data obtained during both seasons displayed that these investigated parameters varied from one measurement to another. Herein, number of both hands and fingers per bunch didn't respond to the investigated N treatments. However, both bunch weight and bunch length of the 500 g actual mineral N + Baker,' yeast

(regardless of its applied rate) treated Maghrabi plants were increased as compared to the analogous ones of those received any of the three other N treatments (control and two combinations of (NH4)2 SO4 at 300 g actual N with Baker,' yeast at either 100 or 50 g / plant). Taking into consideration that response of average bunch weight was more pronounced and significant, while with bunch length it didn't reach level of significance during both seasons of study.V. II. 5. Effect on fruit quality:V. II. 5. 1. Fruit physical properties:Data obtained during both seasons revealed that the response of dimensions related measurements to the investigated Baker,' yeast and ammonium sulphate combinations was less pronounced except finger length, whereas the 500 g actual N + Baker,' yeast at 100 g treated plants induced statistically the tallest fingers. However, the increase in finger diameter; circumference; pedicel length was too slight to be significant. On the other hand, weight related measurements, especially fresh weight of the whole finger and pulp weight showed an obvious response, whereas the 500 g actual mineral N + Baker,' yeast at 100 g / plant treatment exceeded statistically other N treatments in this concern.Meanwhile, three other parameters (peel weight; pulp % and pulp dray matter %) showed no considerable influence.V. II. 5. 2. Fruit chemical properties:Regarding the influence on pulp TSS %; acidity %; TSS / acid ratio; starch and total sugars % of ripe fruits (fingers), data obtained displayed that both TSS and total soluble sugars exhibited more pronounced variances. Since, the 500 g N + 100 g Baker,' yeast treated Maghrabi plants induced statistically the richest fruits in their TSS and sugars%. However, 3 other components showed no considerable response. Moreover, pulp N; P and K contents were not affected, in spite of K % was slightly increased in fruits of 500 g N + 100 g Baker,' yeast treated plants.V. III. Experiment, III:Effect of Baker,' yeast as an additional bio—K fertilizer:In this regard Baker,' yeast at 100 or 50 g / plant combined with K2SO4 at 300 or 150 g actual K20 / plant, beside control (300 g actual K20 / plant) were investigated.V. III. 1. Effect on vegetative growth:Data obtained during both seasons revealed that the investigated vegetative growth parameters varied in their response to the differential K2SO4 x Baker,' yeast combinations. However, it could be generally noticed that both Baker,' yeast combinations with the higher K2SO4 rate (300 g actual K20 / plant + Baker,' yeast at either 50 or 100 g) were the most effective, whereas most investigated growth parameters (pseudostem height; pseudostem circumference; number of green leaves /plant and average leaf area) were increased except number of arisen suckers per plant. However, the increase was more pronounced with both leaf parameters (area & number) rather than of pseudostem (height & circumference).V. III. 2. Effect on measurements of some phenological phases:Regarding the influence of K2SO4 x Baker,' yeast treatments on two investigated measurements of phenological phases varied from one parameter to the other. Hence, the response of duration from sucker emergence to bunch shooting was too slight to be taken into consideration during both seasons. However, the period needed from bunch shooting till harvesting was obviously influenced, whereas, both combinations between higher K2SO4 rate (300 g actual K20 / plant) from one hand and Baker,' yeast at either 100 g (T2) or 50 g (T3) resulted in a significant earliness of fruits maturation (harvesting) rather than three other treatments.V. III. 3. Effect on nutritional status (leaf mineral composition):Data obtained during both seasons declared that the response of nutritional status to the investigated K2SO4 and Baker,' yeast treatments varied greatly from one nutrient element to another. Hence, leaf N; K and Zn contents were increased obviously in Maghrabi plants subjected to the combinations between the higher K2O level (300 g) and Baker,' yeast at either 100 or 50 g per plant, especially higher rate. Such increase exhibited by both superior treatments (300 g K2O + 100 g Baker,' yeast) and (300 g K2O + 50 g Baker,' yeast) in a given nutrient element was significant with comparing to its analogous values detected by the three other investigated treatments. On the other hand, leaf P; Fe; Mn and Cu contents had no appreciable response to the investigated five treatments.V. III. 4. Effect on some productivity / yield measurements:Data obtained during both seasons revealed that measurements of productivity (yield) indices i.e., bunch weight; N° of both hands & fingers per bunch and bunch length varied in their response to different Baker,' yeast and K2SO4 treatments. Since, number of both fingers and hands per bunch, as well as average bunch length didn't respond. However, bunch weight was increased by the higher K2SO4 (300 g actual K20 / plant) in combination with Baker,' yeast at either 100 or 50 g / plant, especially higher level, whereas the increase was more pronounced and significant during both seasons of study.V. III. 5.

Effect on fruit quality:V. III. 5. 1. Fruit physical properties:With regard to the linear (dimensions) related measurements, data obtained during both seasons declared that the response to the differential Baker,' yeast x K2 SO4 combinations was less pronounced, except finger length. Herein, The tallest fingers were always in significant concomitant to (300 g actual K20 + 100 g Baker,' yeast) treated plants, followed by those received 300 g K20 + 50 g Baker,' yeast. On the contrary both control (300 g K20 only) and (150 g K20 + 50 g yeast extract) showed the shortest fingers. However, both finger diameter and circumference followed similar trend to that of finger length but differences were less pronounced and didn't reach level of significance. Moreover, two other linear parameters (pedicle length and peel thickness) had no specific trend and variances were of minor importance.As for the weight related parameters, the response was more pronounced, especially fresh weight of the whole finger; pulp and peel,whereas all followed approximately the same trend and exhibited their maximum values by two combinations of higher K2SO4 rate and Baker,s yeast at its two investigated levels i.e., K2SO4 at 300 g actual K20 / plant + Baker,s yeast at either 100 or 50 g / plant. Differences were significant during both seasons. On the contrary, the least values of such three weight measurements were significantly in closed relationship to fruits of Maghrabi banana plants of either control or the 150 g K,0 + 50 g yeast per plant, whereas both treatments were statistically the inferior and didn't vary as compared each other from the statistical point of view. Meanwhile, percentage of fresh pulp and dry matter of pulp both showed slight variances didn't reach level of significance during two seasons.V. III. 5. 2. Fruit chemical properties:Date obtained displayed that the response of fresh pulp TSS %; acidity % ; TSS / acid ratio; starch % and total sugars % to different Baker,s yeast and K2SO4 treatments were less pronounced to be taken into consideration. Meanwhile, pulp mineral content (N, P, K %) varied from one element to another, whereas two former elements (N&P) didn't respond, while pulp K % was obviously increased by both combinations of higher K2SO4 rate (300 g actual K20 / plant) with Baker,s yeast at either 100 or 50 g especially the higher level which exceeded statistically the three other treatments (control and two combinations of lower K,SO4 level with Baker,s yeast, irrespective of its rate).V. IV. Fourth experiment:In this experiment 4 K fertilization treatments each at 300 g K20 / plant, but varied in source (potassium sulphate or potassium-36%); method (soil or foliar application) and number / date of applicable doses were investigated.V. IV. 1. Effect on vegetative growth:Data obtained during both seasons revealed that five growth measurements under study (pseudostem height & circumference; N° of green leaves; leaf area and N° of suckers / plant) in response to investigated K fertilization treatments followed generally the same trend except former measurement (N° of suckers / plant). Herein, application of two K sources i.e., K,SO4 at the rate of 225 g actual K20/ plant fractionated into 3 equal doses to be soil added in Apr.; Jun. and Aug. + potassium-36% at the rate of 75.0 g K20 foliar spray in Oct. exceeded 3 other K treatments as pseudostem height & circumference; N° of green leaves/plant and average leaf area were concerned. However, the increase was more pronounced and significant as compared to control, while it became less pronounced and didn't reach level of significance in most cases as compared to two other ones. On the other hand, N° of arisen suckers/plant showed no appreciable variations in response to inves-tigated treatments.V. IV. 2. Effect on some measurements of phenological phases:Data obtained during both seasons revealed that two durations of phenological phases extended either (from sucker emergence to bunch shooting) or (from bunch shooting till harvesting) varied in their response to the different K fertilization treatments. Since, the response was less pronounced with the IS` duration (sucker emergence to bunch shooting), however with the second one (bunch shooting till harvesting) it was quite evident and significant. Anyhow, T3 followed by T2 were the most effective and reduced maturation stage significantly than two other treatments. The same trend was also noticed with 1st duration (suckeremergence to bunch shooting) but differences didn't reach level of significance during both seasons.V. IV. 3. Effect on nutritional status (leaf mineral composition):Data obtained during both seasons, revealed obviously that all investigated nutrient elements except K and Zn didn't respond significantly to the different K fertilization treatments. Hence, N; P; Fe; Mn and Cu contents showed slight variances didn't reach level of significance during both seasons. Anyhow, leaf K and Zn content of Maghrabi plants was significantly increased by the 3 investigated K fertilization treatments as compared to that of control. The T3 (225 g K20 as

K,SO4 soil added in Apr.; Jun. and Aug. + 75.0 g K20 as potassium-36% foliar spray in Oct.) was the most effective followed by T2 , while T4 ranked 3rd as compared to the control (the inferior).V, IV. 4. Effect on some measurements of productivity (yield):Concerning the response of productivity indices (bunch weight; of hands & fingers / bunch and bunch length) to the differential K treatments, data obtained during both seasons declared that each character followed its own trend. Anyhow, number of both hands & fingers per bunch didn't respond, while bunch weight and length were obviously respond. Hence, 3 K treatments (T2; T3 and T4) increased both weight and length of Maghrabi bunches, however T3 (225 g actual K20 soil added in Apr.; Jun. and Oct. as K2SO4 + 75.0 g K20 as potassium-36% spray in Oct.) was the most effective and surpassed statistically two other ones.SUMMARY AND CONCLUSIONV. IV. 5. Effect on fruit quality: V. IV. 5. 1. Physical properties:Data obtained during both seasons regarding the response of both linear/dimension and weight related measurements of Maghrabi fruit physical properties to the 4 K fertilization treatments (all at the same rate of 300 g actual K20 but varied in source; method; number and date of application) revealed that the least values of these parameters were always in concomitant to the control (300 g actual K20 in form of K,SO4 soil added in Apr. & Jun.). However, the T3 (225.0 g actual K20 as K,SO4 soil added in Apr.; Jun. and Aug. + 75.0 g actual K20 as potassium-36 % foliar spray in Oct.) was the superior, followed by T2 (300 g actual K20 as K2SO4 soil added in Apr.; Jun.; Aug. and Oct.), while T4 (150 g actual K20 as K2SO4 soil added in Apr. & Aug. + 150 g K,0 as potassium-36 % foliar spray in Jun. & Oct.) ranked third.Nevertheless, the rate of response varied from one measurement to another. Anyhow, the increase was more pronounced with finger length; diameter; circumference and fresh weight of the whole finger, pulp and peel, but the least response was recorded with pedicel length; peel thickness and fresh pulp Meanwhile, pulp dry matter % was intermediate.V. IV. 5. 2. Fruit chemical properties:Data obtained during both seasons displayed that the response of fresh pulp TSS %; acidity %; TSS/acid ratio; starch % and total sugars % to the differential K fertilization treatments was too slight to be considered. Moreover, the influence on pulp N; P and K % proved that both N & P didn't respond. However, with pulp K % the trend took theother way around, whereas control showed the least K level but T3 (225 g K20 as K2SO4 soil added in Apr.; Jun. and Aug. + 75.0 g K20 as potassium-36% foliar spray in Oct.) exhibited usually the highest pulp K%.Generally it could be safely concluded that the obtained result proved the great benefit could be achieved from biofertilizer application either as additional N or K source (Rhizobacterin & Baker,' yeast, respect.) which was positively reflected on most measurements either those related to vegetative growth; nutritional statues; phenological; productivity or fruit qualities. Moreover, K application in more frequent doses along the extension of growing season, especially when three fourth (3/4) of the recommended rate was soil added in Apr.; Jun. and Aug. While one fourth (1/4) foliar spray in Oct. showed the most desirable response. So it could be recommended that providing Maghrabi banana plants with 500/400 g actual N as (NH4)2SO4 + Rhizobacterin or Baker,' yeast at 100 g + 225 g actual K20 as K,SO4 soil added in Apr.; Jun. and Aug. + 75.0 g K2O as potassium-36 % foliar spray in Oct./plant gives the most favourable result under the same conditions of the present study.