I. PROSES REVIEW OLEH TEMAN SEJAWAT

On Thursday, 24 December 2020, 8:30:07 am GMT+7, Sakhidin Sakhidin <sakhidin1207@yahoo.com> wrote:

Kepada :
Yth. Bu Prita Sari Dewi PhD

Assalamualaikum wr wb,

Pertama-tama saya mohon maaf, karena sudah lama dan baru sekarang dapat mengirimkan revisi artikel. Untuk itu saya kirim dua file, yang pertama adalah koreksi dari Bu Prita, sedangkan file yang ke dua adalah revisi dari saya. Revisi atas koreksi dari Bu Prita saya buat dengan tulisan biru, namun demikian revisi secara keseluruhan saya buat untuk menyesuaikan dengan gaya selingkung dari jurnal yang saya tuju yaitu Journal of Applied Horticulture. Untuk perbaikan berikutnya, koreksi dan saran saya tunggu, terima kasih

Wassalam,
Sakhidin
One attachment • Scanned by Gmail

Increasing Yield and Quality of Citrus by Pruning and Fertilization

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Abstract

Pruning and fertilization are factors that can determine the production and quality of citrus. The objective of this research was to study the effect of pruning intensity and doses of N (nitrogen), P (phospor), and K (potassium) fertilizers on production and quality of citrus The research was conducted in a citrus orchard in Central Java, Indonesia over two seasons, 2016-17 and 2017-18. The experiment was conducted as a two-factorial, completely randomized block design where the first factor was pruning intensity, namely 0, 5, 10, and 15% of total number of branches per tree while the second factor was doses of N, P, and K fertilizers, namely 0, 2, and 4% of the weight of harvested citrus fruit in the previous season. The result

of research shows that increasing doses of N, P, K fertilizers from 0 to 4% increased fruit set, harvested fruis, fruit size; content of vitamin C, sugar, and soluble solid. The highest fruit set, weight of harvested fruits, and content of vitamin C were achieved by pruning intensity of 8.37, 8.83, and 8.54% respectively.

Key words: *Citrus nobils* L., pruning intensity, doses of N, P, K fertilizer, sugar.

Comment [PSD1]: Kurangi spasi

Introduction

Citrus (*Citrus nobilis* L.). *is a familiar temperate fruit that contains a variety of vitamins, minerals, fiber, and phytochemicals such as carotenoids, flavonoids, and limonoids, which appear to have biological activities and health benefits (Berk, 2016). There is considerable evidence that citrus fruit has antioxidant and antimutagenic properties and a positive association with the health of bones, cardiovascular and immune systems (Codoňer-Franch and Valls-Bellés, 2010). Citrus consumption might improve indices of antioxidant status, and possibly cardiovascular health and insulin sensitivity (Turner and Burri, 2013).*

One of the most important practices to maintain the health of a tree is pruning because it impacts the tree's health and structure (Clark and Matheny, 2010). Pruning can improve photosynthesis by improving sunlight penetration (Taiz and Zeiger, 2010; Sharma *et al*., 2006), so it can produce more flowers and fruits (Ghosh *et al*., 2016; Santoso, 2012; Willaume *et al*., 2004). Pruning is a cultivation technique that allows a farmer to form and arrange the plant canopy to effectively produce flowers and fruits (Santoso, 2012). Sunlight not only influences flowering and fruitset but also enhances fruit quality and colour development (Dhaliwal *et al*., 2014; Abobatta, 2019). Pruning application is important to control the shape and health of tree and to stabilize fruit production (Dhillon and Thakur, 2014). There is not study about appropiate pruning intensity for citrus. Susanto *et al*. (2019) said that the objective of pruning is to increase the sunshine penetration at inner side of canopy at least 30%. This sunshine penetration was achieved by pruning 10% of total number

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of branches every tree. By this based-on total number branches pruning, the branhes was cut from the top to inner side, so the sun shine can penetrate better to inner side of the shoot.

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Abobatta (2018) stated that fertilization is a cultivation tehnique to improve the nutrient availability of soil for optimizing yield. Fertilization will directly affect the growth, fruit set, retention yield and quality improvement and sustainable production of Kinnow orchards (Huang *et al*., 2014; Yasseen and Manzoor, 2010). Macronutrients, particularly N, P and K are needed by citrus plants in large quantities, and play an important role in fruit yield and quality (Srivastava and Singh, 2009). Generally, farmer apply the fertilizer for citrus trees based on common recomendation dose, not yet based on the number of lost nutrient due to harvesting. Sutopo (2011) stated that one of the aims of applying fertilizer is to replace lost nutrients at harvest. The average dose of fertilizer application for citrus (*Citrus nobilis* 'Pontianak') is 2-3% of the weight of harvested citrus fruit and added nutrients are in the form of 10 N: 7 P_2O_5: 2 K_2O.

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We hypothesized that pruning and application of N, P, and K fertilizer increased the yield and quality of citrus. Thus, the objective of this research was to test this hypothesis and identify the best of pruning intensity and doses of N, P, and K fertilizer for higher yield and quality of citrus.

Materials and Methods

The experiment was conducted in a citrus orchard (60 m asl, 7.44^o S and 109.43^o E) in Kembangan Village, Bukateja District, Purbalingga Regency, Central Java, Indonesia. The study was conducted from June 2016 until June 2018. Average rainfall was 142.15 mm per month, average air temperature was 24-37°C, and there was an average of 7 sunshine h per day (data from a local metereological station). We used 36 four-year-old *C. nobilis* 'Pontianak' trees in both seasons. All trees had uniform growth, age, and cultivation

techniques.

There were two factors arranged in a completely randomized block design. The first factor was pruning intensity, 0, 5, 10, and 15% of total number of tertiary branches per tree; the second one was doses of N, P, and K fertilizer : 0, 2, and 4% of the weight of harvested citrus fruit per tree in the previous season (about 20 kg). There were 12 treatment combinations with three replications, so 36 trees in total.

At first, the total number of branches of every tree was counted. There was an average of 250 branches per tree. All treatments were adjusted for the same number of branches, and the selected tertiary branches (diseased, damaged, non productive, or structural unsound) were cut or pruned using shears. Branches were pruned in June of 2016 and 2017.

We applied N, P_2O_5, and K_2O as urea (PT Pupuk Sriwidjaja, Palembang, Indonesia), SP36 (PT Petrokimia, Gresik, Indonesia), and ZK (PT Petrokimia), respectively. For a 5% fertilization dose, we added the following nutrients per tree: 20 kg × (0.05 × 10:19) or 526.32 g N, 20 kg × (0.05 × 7:19) or 368.42 g P_2O_5, and 20 kg × (0.05 × 2:19) or 105.26 g K_2O per plant. In the same way, 1,052.64 g N, 736.84 g P_2O_5, and 210.52 g K_2O was added for a fertilization dose of 10%, and 1,578.96 g N, 1,105.26 g P_2O_5, and 315.78 g K_2O for a fertilization dose of 15%. Initially, fertilizer was dissolved in 3 litres of water then poured at the soil surface around the base of the stem of each citrus tree. Fertilizer was applied twice: 50% of the dose was applied one month after pruning and the remainder one week later. No serious pests or diseases were detected, so no control sprays were applied. Furrow irrigation was used to water citrus trees.

Several fruit yield variables were observed: 1) fruitset (ratio between the number of fruits formed and the number of flowers of the same tree); 2) number of harvested fruits per tree; 3) weight of harvested fruits per tree; 4) fruits drop. The fruit quality variables observed were: 1) average of weight per fruit; 2) average of fruit diameter; 3) content of vitamin C, which

Comment [PSD5]: fruit

was measured using a titration method with 0.01 N iodine solution; 4) total acid was measured using a titration method with 0.1 N NaOH solution; 5) sugar content (^{o}Brix) was measured by a hand refractometer (Atago N-1, Saitama, Japan); 6) content of soluble solids, which was measured by an electrical conductivity method (TDS 6 + TDS/Temp, Eutech Instruments Pte Ltd., Singapore). Data were analyzed by ANOVA with SAS version 9. Means were separated using the least significant difference (LSD) test ($p<0.05$).

Results and Discussion

Immediately after pruning the branches, light intensity was measured at a depth of about 20 cm in the canopy for every pruning intensity with a LX-101 A light meter (Lutron Electronic Enterprise Co. Ltd., Taipei, Taiwan). Light intensity for 0, 5, 10, and 15% pruning was about 125, 465, 780, and 1550 µmol m^{-2} s^{-1}, respectively.

Fruitset and fruit drop : The increase of the doses of N, P, and K fertilizers from 0% until 4% increased fruitset by the equation of Y = 3.0375X+18.833 and R-squared of 0.9185 (Fig. 1). This result shows that to get high fruitset, it needs high dose of N, P, K fertilizers. This result is similar with Ramadhan *et al*. (2015) reported that the highest fruitset (93%) of *Citrus sinensis* Osb. was achieved by application of high dose of N, P, and K fertilizer (400 g per plant). It means that improving nutrient status in plant by application of fertilizer can increase fruitset. Iglesias *et al*. (2007) stated that nutritional status affects flower formation and development and therefore fruitset of citrus. Patil *et al*. (2018) added that increased fruit set could be due to increased flower production. Fig. 1 shows that the increase of doses of N, P, and K fertilizers decreased fruit drop of citrus. Application of 4% N, P, and K fertilizers reduced fruit drops as 19.51% compared to without application of N, P, and K fertilizers. Saleem *et al* (2005) recorded minimum fruit drop in trees of *Citrus reticulata* Blanco fertilized of N, P, K with higher dose in two split (3.0 kg).

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Comment [PSD7]: penulisan varietas di belakang nama spesies perlu disesuaikan dengan Guidance for Author di jurnal yang dituju, apakah akan disingkat mjd *C. sinensis* Osb. Atau *C. sinensis* Osbeck. Nama panjang genus sdh ada di Introduction jadi perlu disingkat

Comment [PSD8]: apakah ini bisa dikonversi menjadi % Prof? Atau adakah literatur lain yang menggunakan % from the harvested citrus weight? Untuk mendukung hasil riset ini

Comment [PSD9]: *C. reticulata* Blanco

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Fig. 2 shows that the increase of pruning intensity increase fruitset by equation of $Y = -0.1341x^2 + 2.246x + 19.8$ and value of R-squared of 0.8375. By calculating this equation, pruning intencity of 8.37% gave the highest fruitset (29.27%). Dhillon and Thakur (2014) said that one of the objectives of pruning is to increase fruitset. Susanto *et al*. (2019) reported that pruning by leaving 4 and 8 pairs of leaves increased fruit number by 85.22 and 50.74%, respectively compared to control plants that only produced 20.3 fruits per plant. According to Willaume *et al*. (2004), sunlight received by pruned apple plants will increase so that it can stimulate the growth of productive new shoots. Application of the appropiate pruning intensity also can reduce the fruit drop rate by equation of $y = 0.17x^2-4.0497x+61.415$ (Fig 8). By calculating this equation, the lowest fruit drop (37.3%) was achieved by application of pruning at intensity of 11.91%

The number and weight of harvested fruits : The increase of fruitset by application of higher dose of N, P, and K fertilizers was followed by the increase of number of harvested fruits and weight of harvested fruits (Fig 3). Our results are similar to the results of Dubey and Yadav (2003), who showed that highest yield (163.3 kg per tree or increased 150% compared to control) of 'Khasi' mandarin was obtained at high doses (110 kg of pig manure + 750 g of N + 650 g of K_2O). A similar result was reported by Amina *et al*., (2018) where the most 'Kinnow' mandarin fruits per tree was achieved by a higher dose of fertilizer (250 g P_2O_5 + 150 g K_2O; 200 g P_2O_5 + 250 g K_2O). Li *et al*. (2017) found that fruit yield of *Citrus grandis* var Longanyou was positively correlated with leaf nutrient N, P, and K with a correlation coefficient of 0.472, 0.529, and 0.727 respectively.

The effect of pruning intensity on fruitset followed its effect on number of harvested fruits and weight of harvested fruits Fig (4) by equation of $Y = -1.5643x^2 + 26.303x + 240.88$ and $Y = -0.1737x^2 + 3.0683x + 14.042$ respectively. By calculating this equation, pruning

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Comment [PSD16]: fertilizers

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intensity of 8.41% gave the highest number of harvested fruits (351.45) and 8.83% for highest weight of harvested fruits (27.97 kg).

Fruits size : This research shows that the increase of dose of N, P, and K fertilizers increased weight per fruit and fruit diameter (Fig. 5) by equation of y =5.7033x + 75.911 (R-square of 0.9078) and y = 4.5442x + 44.853 (R-square of 0.9228) respectively. Application of pruning increased weight per fruit and fruit diameter (Fig 6) linearly. Dhillon and Thakur (2014) stated that pruning not only influences flowering and fruit set but also enhances the fruit quality such as fruit size and content of sugar

Fruits nutrition : Content of vitamin C and sugar was increased by application of N, P, and K fertilizers (Fig. 7) . So, it is very important to increase the dose of N, P, K fertilizer for getting higher quality of citrus fruits. Application of N, P, and K fertilizers by dose of 4% increased 8.4% and 10.0% for content of vitamin C and sugar respectively compared to without N, P, and K fertilization. These increase are lower than reported by Han et al (2008), proper application of N, P, and K fertilizers can significantly increase content of sugar by 15-30% and vitamin C by 13-57%.

The effect of pruning intensity on content of vitamin C was indicated by equation of Y = $0.0035X^2 + 0.0598X + 3.2123$ and R-square of 0.925 (Fig 8). The same effect were showed on content of sugar (Fig 8). By calculating the equation, the pruning intensity for getting the highest content of vitamin C and sugar are 8.54% and 8.21% respectively. Lee and and Kader (2000) said that cultural practices such as pruning can influence the nutritional composition of fruits. Li *et al*. (2017) reported that the content of vitamin C and total sugar was positively correlated with leaf nutrients, particularly K, with a correlation coefficient of 0.380 and 0.451, respectively. Aular *et al*. (2017) added that K was the element that most influenced fruit characteristics.

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Content of soluble solid was increased linearly by application of N, P, and K fertilizers (Fig. 9). Fig. 10 shows that effect of pruning intensity was indicated by equation of y = -3.3233x2 + 63.177x + 1104.9 and R-square of 0.8923. By calculating the equation, the highest content of soluble solid was achieved by pruning of 10.1%.

Content of total acid was not effected by doses of N, P, and K fertilizers and pruning intensity. Content of total acid for dose of N, P, and K fertilizer of 0, 2, and 4% are 14.70, 13.49, and 15.13% respectively. Amina *et al*. (2018) noticed that total soluble solids /acid ratio were not affected by fertilizer dose. Application of pruning of 0, 5, 10, and 15% gave content of total acid of 15.50, 14.53, 13.48, and 14.24 respectively. Li *et al*. (2017) noted that total soluble solid (TSS) and total acid content were not significant correlated with leaf nutrient N, P, and K rate. Susanto *et al*. (2019) reported that TSS and total acid content in guava were not affected by pruning.

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Overall, this study shows that application of appropriate pruning intensity and dose of N, P, and K fertilizers increased yield and quality of citrus. Similarly with that reported by Li *et al* (2019), N, P, and K fertilizer and their interaction significantly influence the yield and quality of citrus. Saleem *et al* (2005) added that application of fertilizer significantly affected leaf N, P, and K content. Fertilizer application is very important to improve the nutrient status of citrus trees (Alva *et al*., 2006; Zhao *et al*. (2013

Conclusions

Increasing doses of N, P, K fertilizers from 0 to 4% increased fruit set, harvested fruis, fruit size; content of vitamin C, sugar, and soluble solid. The highest fruit set, weight of harvested fruits, and content of vitamin C were achieved by pruning intensity of 8.37, 8.83, and 8.54% respectively. However, the pruning intensity and doses of N, P, and K fertilizer did not influence the content of total acid.

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Acknowledgements

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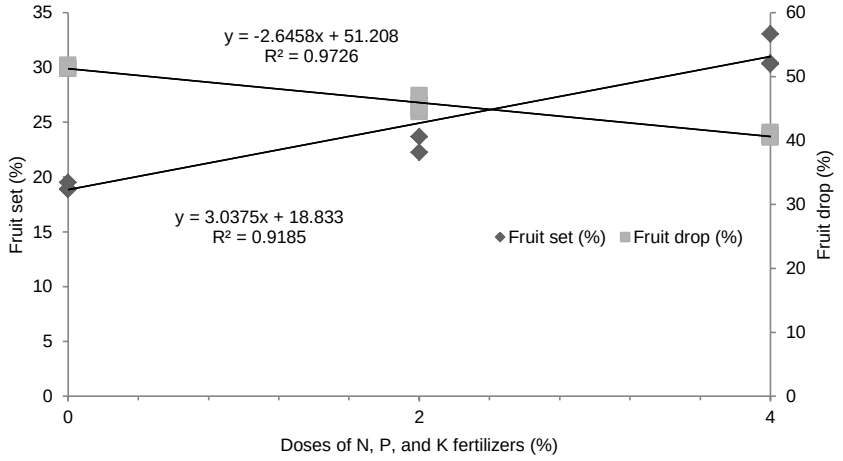


Fig. 1. Effect of doses of N, P, and K fertilizers on fruit set and fruit drop

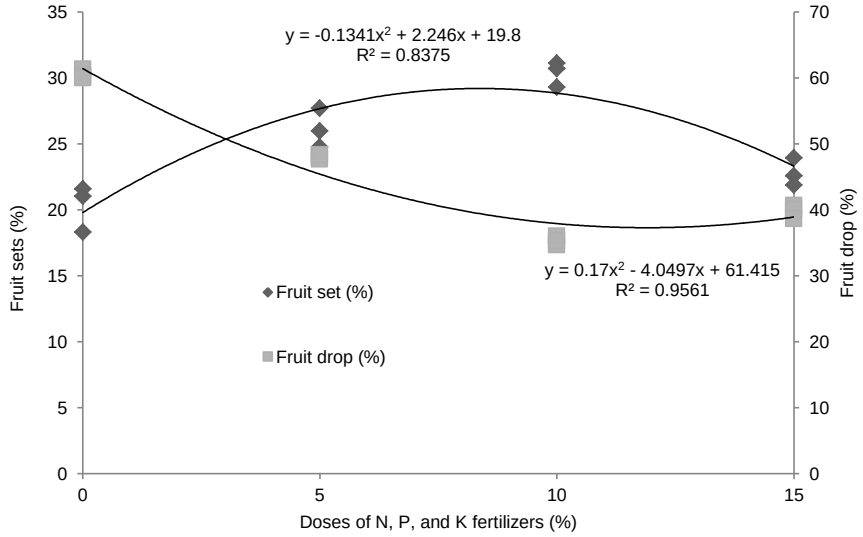
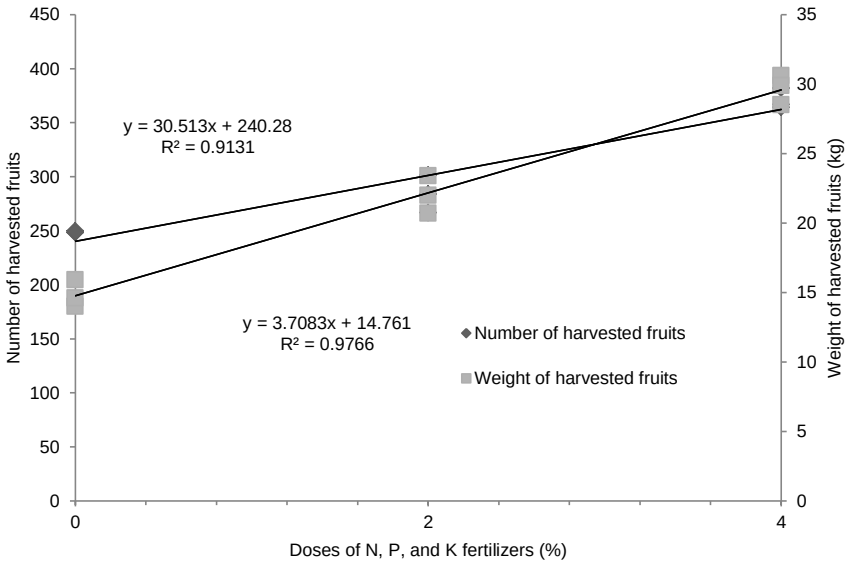
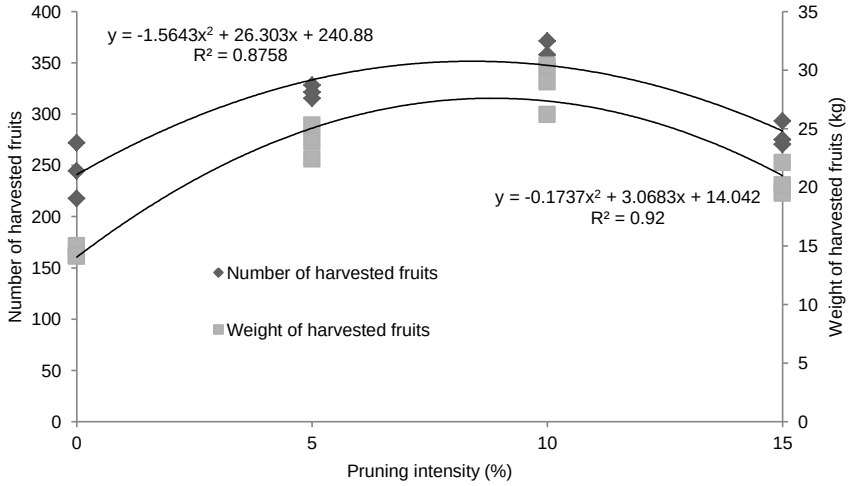


Fig. 2. Effect of pruning intensity on fruit set and fruit drop



Gambar 3. Effect of doses of N, P, and K fertilizers on number of harvested fruits and weight of harvested fruits



Gambar 4. Effect of pruning intensity on number of harvested fruits and weight of harvested fruits

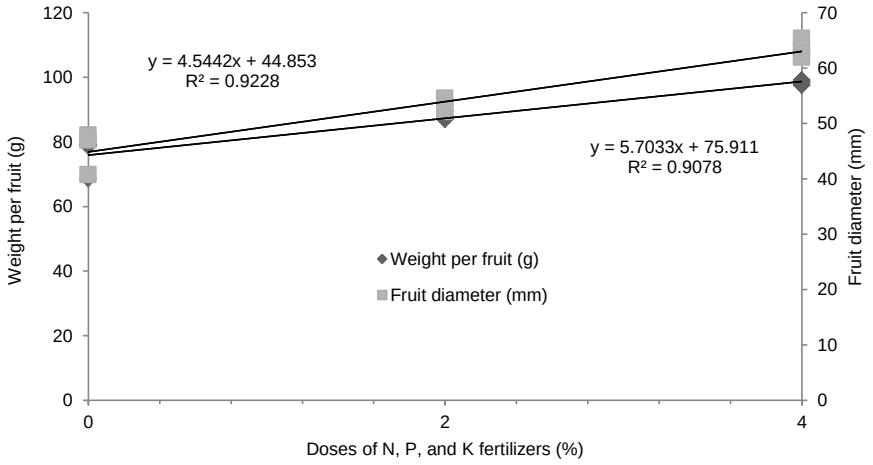
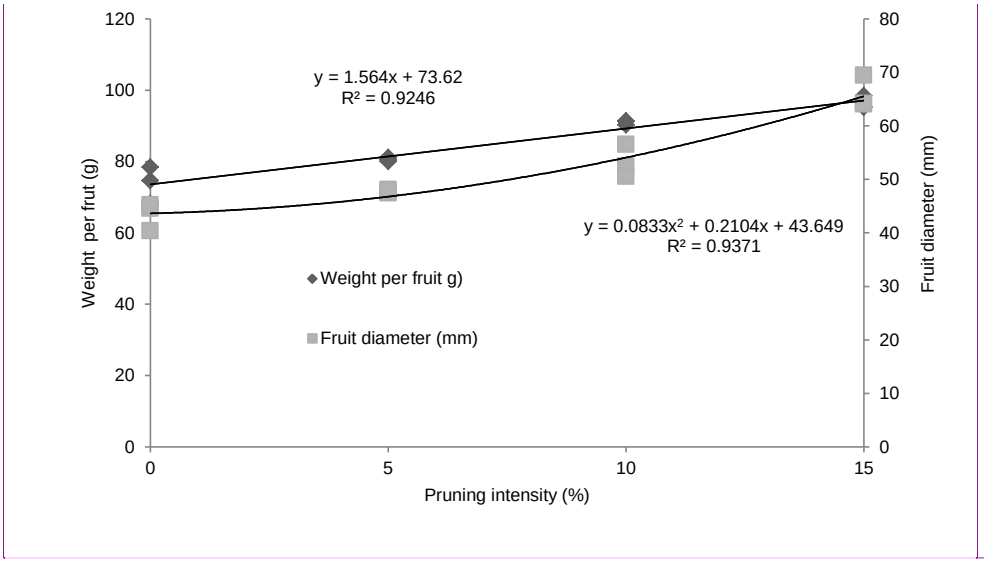


Fig. 5. Effect of doses of N, P, and K fertilizer on weight per fruit and fruit diameter



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Comment [PSD33]: fruit

Fig. 6. Effect of pruning intensity on weight per fruit and fruit diameter

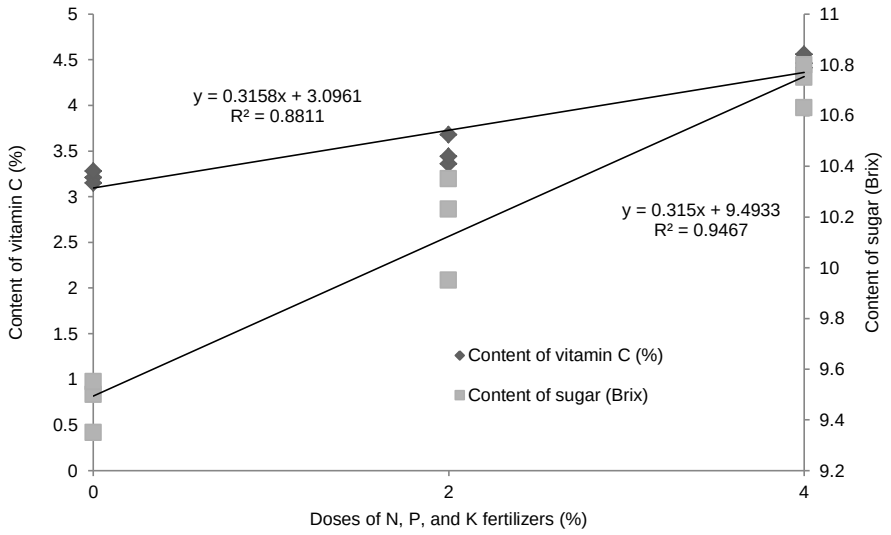

Fig. 7. Effect of doses of N, P, and K fertilizer on content of vitamin C and of sugar

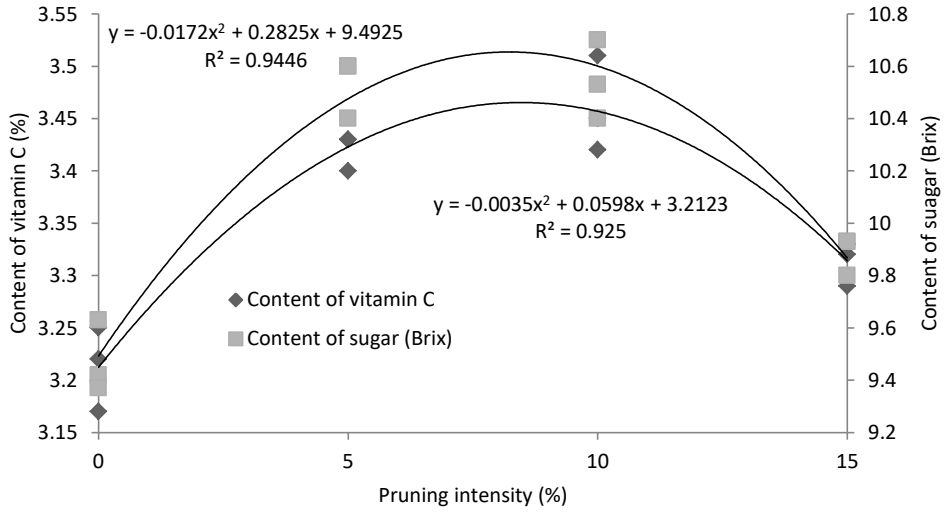

Fig. 8. Effect of pruning intensity on content of vitamin C and sugar

Comment [PSD34]: of sugar

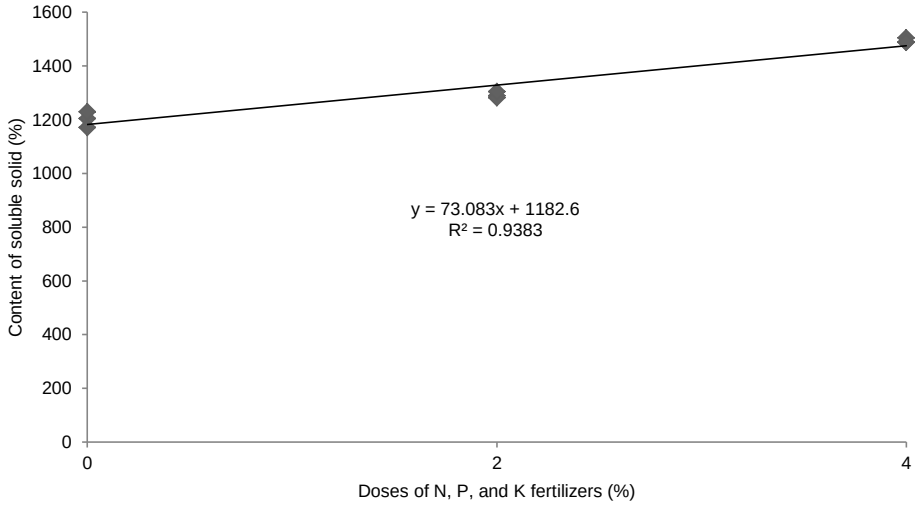

Fig. 9. Effect of doses of N, P, and fertilizers on content of soluble solid

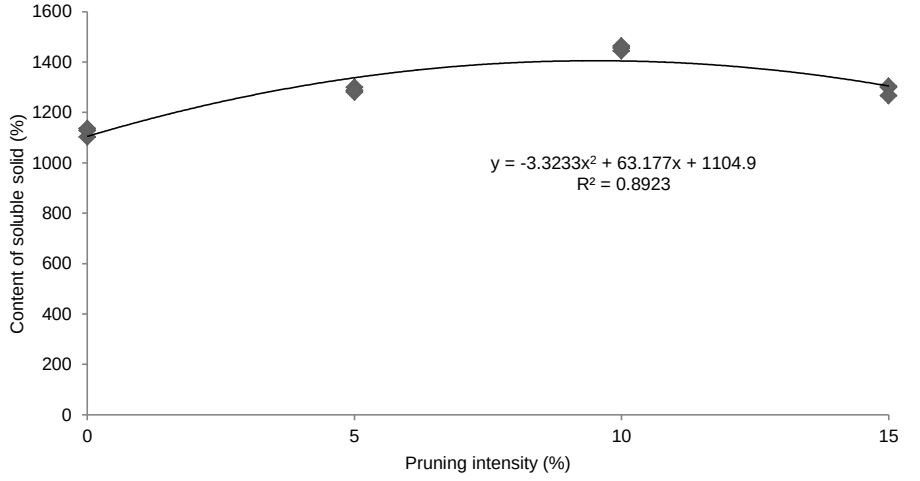

Fig. 10. Effect of pruning intensity on content of soluble solid

Prita Sari Dewi <p_saridewi@yahoo.com> Fri, Jan 15, 2021, 8:34 AM

to me, Sakhidin1207, sakhidin_07@yahoo.com

Indonesian
English

Translate message

Turn off for: Indonesian

Yth. Prof. Sakhidin,

Terlampir adalah sedikit sekali masukan dari saya.
Saya kira sudah siap untuk di-submit.
Semoga lancar dan dapat segera accpeted.
Matur nuwun dan mohon maaf atas segala kekeliruan.

Salam,
Prita

Dr. Prita Sari Dewi
Lab. of Plant Breeding and Biotechnology
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EFFECT OF PRUNING INTENSITY AND DOSAGES OF NITROGEN, PHOSPHOR, AND POTASSIUM FERTILIZER ON PRODUCTION AND QUALITY OF CITRUS

Comment [PSD35]: doses

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Abstract

Pruning and fertilization are factors that can determine the production and quality of citrus. The objective of this research was to study the effect of pruning intensity and dosages of N (nitrogen), P (phospor), and K (potassium) fertilizer on production and quality of citrus

Comment [PSD36]: doses

(*Citrus nobilis*). The research was conducted in a citrus orchard in Central Java, Indonesia over two seasons, 2016-17 and 2017-18. The experiment was conducted as a two-factorial, completely randomized block design where the first factor was pruning intensity, namely 0, 5, 10, and 15% of total number of branches per tree while the second factor was dosages of N, P, K fertilizer, namely 0, 2, and 4% of the weight of harvested citrus fruit in the previous season. Higher fruitsets and content of vitamin C was achieved by higher dosages of N, P, K fertilizer especially if the citrus trees were not pruned. Especially at pruning of 15%, higher dosages of N, P, K fertilizer are needed to get higher content of sugar. These results indicate that higher dosages of N, P, K, fertilizer are needed to get higher production and quality of citrus.

Key words: pruning intensity, dosages of N, P, K fertilizer, sugar, *Citrus nobilis*.

Abbreviations : ANOVA – Analysis of Variance; asl – above sea level; K – Potassium; K_2O – Potassium Oxide; LSD – Least Significance Level; N – Nitrogen; NaOH – Natrium Oxide; P – Phosphor; P_2O_5 – Phosphor Oxide; PT – Perseroan Terbatas (in Indonesia), Limited Company; SAS – Statistical Analysis System; SP36 – Super Phosphate 36; TSS - total soluble solids; ZK – Zwavelzure Kali

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Introduction

Citrus is a familiar temperate fruit that contains a variety of vitamins, minerals, fiber, and phytochemicals such as carotenoids, flavonoids, and limonoids, which appear to have biological activities and health benefits (Berk, 2016). There is considerable evidence that citrus fruit has antioxidant and antimutagenic properties and a positive association with the health of bones, and cardiovascular and immune systems (Codoňer-Franch & Valls-Bellés, 2010). Citrus consumption might improve indices of antioxidant status, and possibly cardiovascular health and insulin sensitivity (Turner & Burri, 2013).

One of the most important practices to maintain the health of a tree is pruning because it

Comment [PSD37]: and

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impacts the tree's health and structure (Clark & Matheny, 2010). Pruning can improve photosynthesis by improving sunlight penetration (Taiz & Zeiger, 2010; Sharma *et al*., 2006), so it can produce more flowers and fruits (Ghosh *et al.*, 2016; Santoso, 2012; Willaume *et al.*, 2004). Pruning is a cultivation technique that allows a farmer to form and arrange the plant canopy to effectively produce flowers and fruits (Santoso, 2012). Sunlight not only influences flowering and fruitset but also enhances fruit quality and colour development (Dhaliwal *et al*., 2014; Abobatta, 2019). Abobatta (2018) said that full sun is needed by citrus trees. But, there is very little of farmer that have been practiced the pruning for citrus trees. It may be caused by there were not the exactly intensity of pruning to get the high benefits. Beside that, according to many references, study of pruning intensity was based on cutting from the top to inner side. By this research, we use pruning intensity based on the total number of branch before pruning conducted.

Comment [PSD40]: Kalimat2 ini sebaiknya difokuskan pada alasan pentingnya pruning dilakukan dan novelty antara penelitian ini dengan penelitian yang telah dilakukan sebelumnya.

Comment [PSD41]: Perlu dilakukan justifikasi mengapa metode ini dipilih dan apa ekspektasi (hipotesis) yang diharapkan. Ekspektasi tersebut akan terkait dengan jenis variabel pengamatan. Konsekuensi dari pruning adalah menurunnya jumlah bunga dan buah, tetapi akan diiringi dengan meningkatnya kualitas buah baik secara morfologi maupun fisiologis sehingga karakter2 tsb penting untuk diamati.

Abobatta (2018) stated that fertilization is a cultivation tehnique to improve the nutrient availability of soil for optimizing yield. Fertilization will directly affect the growth, fruit set, retention yield and quality improvement and sustainable production of Kinnow orchards (Huang *et al*., 2014; Yasseen & Manzoor, 2010). Macronutrients, particularly N, P and K are needed by citrus plants in large quantities, and play an important role in fruit yield and quality (Srivastava & Singh, 2009). Generally, farmer apply the fertilizer for citrus trees based on common recomendation dosage, not yet based on the number of lost nutrient due to harvesting. Sutopo (2011) stated that one of the aims of applying fertilizer is to replace lost nutrients at harvest. The average dosage of fertilizer application for citrus (*Citrus nobilis* 'Pontianak') is 2-3% of the weight of harvested citrus fruit and added nutrients are in the form of 10 N: 7 P_2O_5: 2 K_2O.

We hypothesized that pruning intensity and dosages of N, P, K fertilizer influence production and quality of citrus. Thus, the objective of this research was to test this

hypothesis and identify the best combination of pruning intensity and dosage of N, P, K fertilizer for higher production and quality of citrus.

Materials and Methods

The experiment was conducted in a citrus orchard (46 m asl) in Kembangan Village, Bukateja District, Purbalingga Regency, Central Java, Indonesia for two seasons (two years), from June 2016 until June 2018. Average rainfall was 142,15 mm/month, average air temperature was 24-37°C, and there was an average of 7 sunshine h/day (data from a local metereological station). We used 36 four-year-old *C. nobilis* 'Pontianak' trees in both seasons. All trees had uniform growth, age, and cultivation techniques.

There were two factors arranged in a completely randomized block design. The first factor was pruning intensity, 0, 5, 10, and 15% of total number of tertiary branches per tree; the second one was dosages of N, P, and K fertilizer : 0, 2, and 4% of the weight of harvested citrus fruit per tree in the previous season (about 20 kg). There were 12 treatment combinations with three replications, so 36 trees in total.

Comment [PSD42]: Referensi yang menjadi landasan penentuan level pruning perlu disampaikan di pendahuluan

At first, the total number of branches of every tree was counted. There was an average of 250 branches per tree. All treatments were adjusted for the same number of branches, and the selected tertiary branches (diseased, damaged, non productive, or structural unsound) were cut or pruned using shears. Branches were pruned in June of 2016 and 2017.

We applied N, P_2O_5, and K_2O as urea (PT Pupuk Sriwidjaja, Palembang, Indonesia), SP36 (PT Petrokimia, Gresik, Indonesia), and ZK (PT Petrokimia), respectively. For a 5% fertilization dosage, we added the following nutrients per tree: 20 kg × (0.05 × 10:19) or 526.32 g N, 20 kg × (0.05 × 7:19) or 368.42 g P_2O_5, and 20 kg × (0.05 × 2:19) or 105.26 g K_2O per plant. In the same way, 1,052.64 g N, 736.84 g P_2O_5, and 210.52 g K_2O was added for a fertilization dosage of 10%, and 1,578.96 g N, 1,105.26 g P_2O_5, and 315.78 g K_2O for a

fertilization dosage of 15%. Initially, fertilizer was dissolved in 3 litres of water then poured at the soil surface around the base of the stem of each citrus tree. Fertilizer was applied twice: 50% of the dosage was applied one month after pruning and the remainder one week later. No serious pests or diseases were detected, so no control sprays were applied. Furrow irrigation was used to water citrus trees.

Several fruit production variables were observed: 1) fruitset (ratio between the number of fruits formed and the number of flowers of the same tree); 2) number of harvested fruits per tree; 3) weight of harvested fruits per tree. The fruit quality variables observed were: 1) content of vitamin C, which was measured using a titration method with 0.01 N iodine solution; 2) total acid was measured using a titration method with 0.1 N NaOH solution; 3) sugar content (^{o}Brix) was measured by a hand refractometer (Atago N-1, Saitama, Japan); 4) content of soluble solids, which was measured by an electrical conductivity method (TDS 6 + TDS/Temp, Eutech Instruments Pte Ltd., Singapore). Data were analyzed by ANOVA with SAS version 9. Means were separated using the least significant difference (LSD) test ($p<0.05$).

Comment [PSD43]: Apabila masih ada data morfologis dan fisiologis yang diamati maka dapat ditambahkan, misal: ukuran rata2 buah, berat rata2, dll

Results and Discussion

Immediately after pruning the branches, light intensity was measured at a depth of about 20 cm in the canopy for every pruning intensity with a LX-101 A light meter (Lutron Electronic Enterprise Co. Ltd., Taipei, Taiwan). Light intensity for 0, 5, 10, and 15% pruning was about 125, 465, 780, and 1550 µmol m^{-2} s^{-1}, respectively.

Fig 1 shows that effect of dosages of N, P, K fertilizer on fruitset depended on pruning intensity. Without pruning (0% pruning), effect of dosages of N, P, K fertilizer gave the equation of $y = 0.9025x^2+0.14x+21.57$ and R-squared of 0.9521. By calculating this

equation, dosage of N, P, K fertilizer of 0.19% gave the lowest fruitset (22.57%). At pruning of 10%, effect of dosage of N, P, K fertilizer on fruitset was showed by equation of $y = 0.8525x^2–0.065x+14.64$. By the same way, dosage of N, P, K fertilizer of 0.04% gave the lowest fruitset of 14.64%. At pruning of 5 and 15%, effect of dosages of N, P, K fertilizer on fruitset gave low value of R-squared namely 0.6831 and 0.7796 respectively. This result shows that to get high fruitset, it needs high dosage of N, P, K fertilizer especially when the citrus trees were not pruned. Improving the nutrient avalaibility in soil that improve nutrient status in plant by application of fertilizer increased fruitset. Iglesias *et al.* (2007) stated that nutritional status affects flower formation and development and therefore fruitset of citrus. Our results are similar to the results of Dubey & Yadav (2003), who showed that highest yield (163.3 kg per tree or increased 150% compared to control) of 'Khasi' mandarin was obtained at high dosages (110 kg of pig manure + 750 g of N + 650 g of K_2O). Fertilizer application is very important to improve the nutrient status of citrus trees (Alva *et al*., 2006). Zhao *et al*. (2013) stated that rational application of fertilizer (half inorganic N, P, and K combined with half swine manure) can significantly improve fruit yield of 'Fuji' apple. Patil *et al*. (2018) added that increased fruit set could be due to increased flower production (not presented).

Comment [PSD44]: Kalimat ini perlu diperbaiki karena tdk memiliki predikat da nada pengulangan kata improve. Tentu saja pohon yang tidak dipangkas akan membutuhkan lebih banyak nutrisi. Hal yang perlu diberikan penjelasan adalah mengapa dalam penelitian ini beberapa variabel yang diamati tidak dipengaruhi oleh pruning seperti yang diharapkan pada pendahuluan.

Effect of dosages of N, P, K fertilizer on number of harvested fruits depended on pruning intensity. It was indicated by different equation and value of R-squared for each pruning intensity. But, all pruning intensity need higher dosages of N, P, K fertilizer to get higher number of harvested fruits by quadratic polinomials (Fig. 2). A similar result was reported by Amina *et al*., (2018) where the most 'Kinnow' mandarin fruits per tree was achieved by a higher dosage of fertilizer (250 g P_2O_5 + 150 g K_2O; 200 g P_2O_5 + 250 g K_2O). Susanto *et al*. (2019) added that pruning by leaving 4 and 8 pairs of leaves increased fruit number by 85.22 and 50.74%, respectively compared to control plants that only produced 20.3 fruits per plant.

According to Willaume *et al*. (2004), sunlight received by pruned apple plants will increase so that it can stimulate the growth of productive new shoots. Li *et al*. (2017) found that fruit yield of *Citrus grandis* var Longanyou was positively correlated with leaf nutrient N, P, and K with a correlation coefficient of 0.472, 0.529, and 0.727, respectively. The effect of pruning intensity and dosages of N, P, K fertilizer on number of harvested fruits followed their effect on weight of harvested fruits although by lower value of R-squared (Fig 3).

Fig 4 shows that at 0% pruning, effect of dosages of N, P, K fertilizer on content of vitamin C was indicated by equation of $y = 0.0167x^2 + 0.1083x + 3.1$ and a high value of R-square (0.8903). At others pruning intensity, the same effect were indicated by low value of R-squared. So, it is very important to increase the dosage of N, P, K fertilizer for getting higher content of vitamin C especially when the citrus trees were not pruned. Content of sugar in citrus fruits was influenced by dosages of N, P, K fertilizer especially if trees were pruned at intensity of 15%. At this pruning intensity, the increase of dosages of N, P, K fertilizer increased content of sugar by equation of $y = 0.2338x^2 + 1.1025x + 10.67$ and R-squared of 0.8057 (Fig 5).

According to the calculation of its equation, at 0% pruning the lowest content of vitamin C (3.63 $mg100g^{-1}$) was achieved by application of 3.24 % N, P, K fertilizer. At 15% pruning, the lowest content of sugar (9.37^{o}Brix) was achieved with 2.36% N, P, K. Li *et al*. (2017) reported that the content of vitamin C and total sugar was positively correlated with leaf nutrients, particularly K, with a correlation coefficient of 0.380 and 0.451, respectively. Aular *et al*. (2017) added that K was the element that most influenced fruit characteristics.

Our study shows that the content of soluble solids and total acid was not influenced by hand pruning rate or fertilizer dosage (Table 1). Amina *et al*. (2018) also noticed that total soluble solids (TSS) content and TSS/acid ratio were not affected by fetilizer dosage. Li *et al*. (2017) noted that TSS and total acid content were not significant correlated with leaf nutrient

N, P, and K rate. Susanto *et al*. (2019) reported that TSS and total acid content in guava were not affected by pruning.

Conclusions

At a certain pruning intensity, increasing dosages of N, P, K fertilizer from 0 to 4% increased fruitset, number and weight of harvested fruits, content of vitamin C and sugar in citrus. However, the pruning intensity and dosages of N, P, and K fertilizer did not influence the content of soluble solids and total acid.

Acknowledgements

The authors thank the General Directorate of Higher Education, Ministry of Research, Technology and Higher Education of Indonesia for research funding as written in the implementation contract of competitive loan from the Institute for Research and Community Services of Jenderal Soedirman University No. 2350/UN23.14/PN.01.00/2018.

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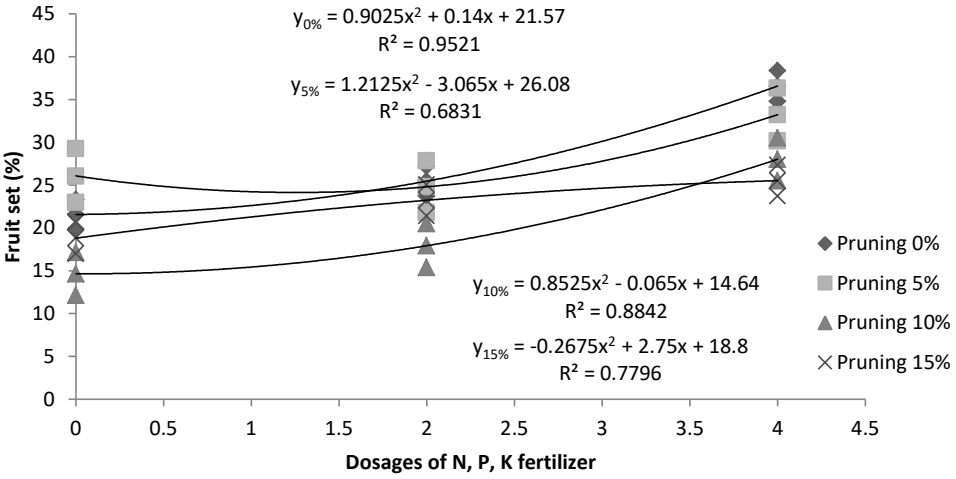

Fig. 1. Effect of pruning intensity and dosages of N, P, K fertilizer on fruitset (%)

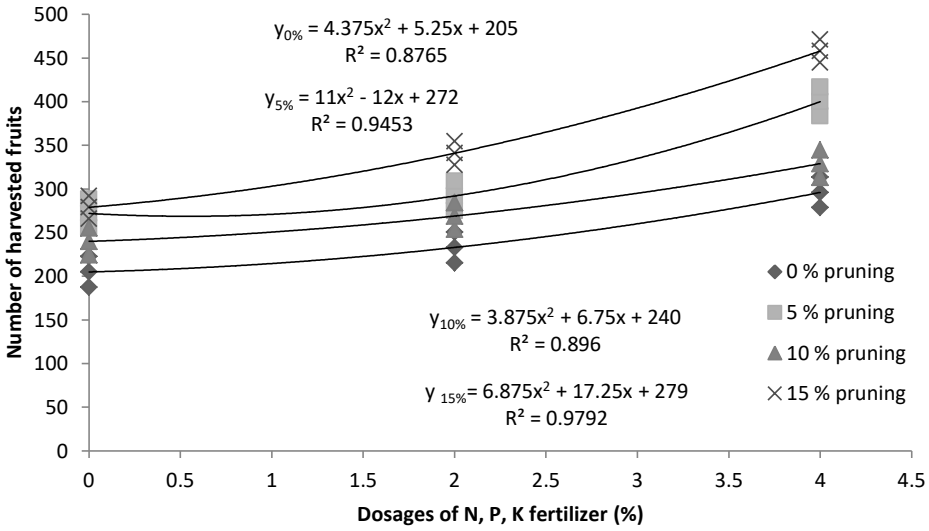

Fig 2. Effect of pruning intensity and dosages of N, P, K fertilizer on number of harvested fruits

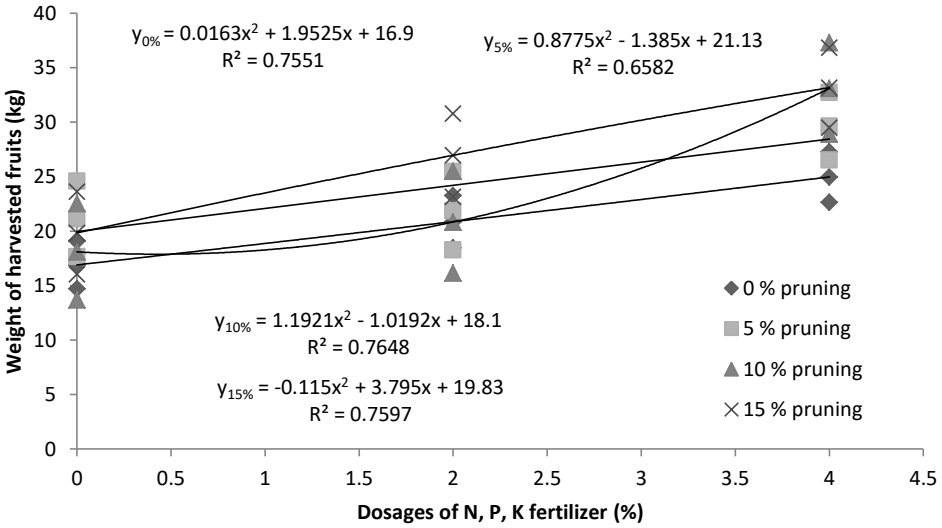

Fig 3. Effect of pruning intensity and dosages of N, P, K fertilizer on weight of harvested fruits (kg).

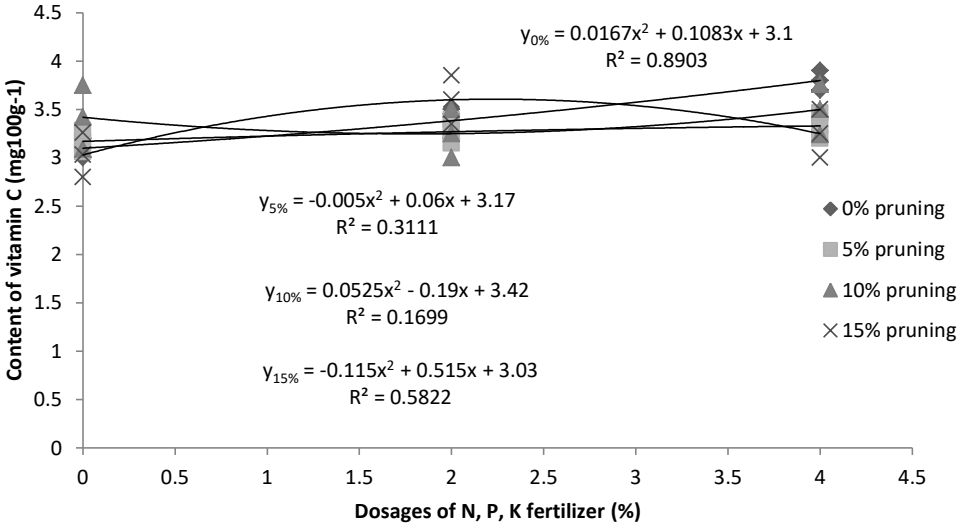

Fig 4. Effect of pruning intensity and dosages of N, P, K fertilizer on content of vitamin C (mg 100 g^{-1}).

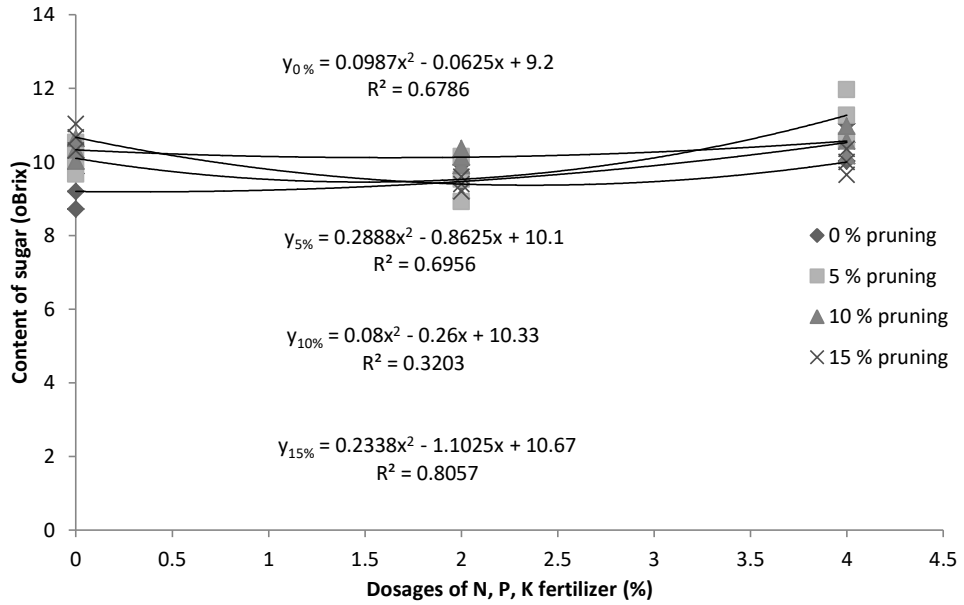

Fig 5. Effect of pruning intensity and dosages of N, P, K fertilizer on content of sugar (°Brix)

Table 1. Effect of pruning intensity and dosages of N, P, K fertilizer on content of soluble solids (ppm) and total acid (%)

Prunings intensity (%)	Content of soluble solids (ppm)		Content of total acid (%)	
	2016/2017	2017/2018	2016/2017	2017/2018
0	$1214^{x} \pm 123.29^{a}$	1141 ± 158.16^{a}	15.50 ± 3.45^{a}	16.59 ± 3.54^{a}
5	1152 ± 112.51^{a}	1229 ± 153.38^{a}	13.48 ± 2.35^{a}	14.68 ± 3.28^{a}
10	1367 ± 117.84^{a}	1289 ± 161.89^{a}	14.53 ± 2.68^{a}	15.94 ± 2.38^{a}
15	1348 ± 133.81^{a}	1420 ± 168.56^{a}	14.24 ± 2.55^{a}	15.72 ± 3.38^{a}
F value	2.24^{ns}	3.02^{ns}	0.47^{ns}	0.43^{ns}
Dosages of N, P, K fertilizer (%)				
0	$1220^{xx} \pm 145.48^{a}$	1223 ± 150.04^{a}	14.70 ± 3.78^{a}	15.47 ± 2.95^{a}
2	1381 ± 192.55^{a}	1291 ± 158.09^{a}	13.49 ± 3.68^{a}	15.37 ± 3.41^{a}
4	1208 ± 163.57^{a}	1295 ± 155.49^{a}	15.13 ± 3.87^{a}	16.36 ± 3.14^{a}
F value	2.57^{ns}	0.68^{ns}	0.65^{ns}	0.27^{ns}

^{ns} non-significant at $p = 0.01$; ^{x} mean values and standard deviation (n=9); ^{xx} mean values and standard deviation (n=12); values followed by different lower-case letters within a column or upper-case letters within a row are significantly different at $p = 0.05$ (DMRT test); F value – *F* statistic for interaction from ANOVA

Subject: Re: Revisi artikel

Wa'alaikumsalam w.w.

Yth. Prof Sakhidin,

Pangapunten sanget baru bisa menyelesaikan review dari manuskrip Bpk.
Matur nuwun atas perkenannya.

Salam,
Prita

Dr. Prita Sari Dewi
Lab. of Plant Breeding and Biotechnology
Faculty of Agriculture http://www.faperta.unsoed.ac.id/
Jenderal Soedirman University http://www.unsoed.ac.id/
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II. PROSES KOMUNIKASI DENGAN EDITOR JOURNAL OF APPLIED HORTICULTURE

Purwokerto-Indonesia, 14 th January, 2021

Sakhidin
Purwokerto, Central Java, Indonesia
Email : sakhidin@unsoed.ac.id
The Editor in Chief, Journal of Applied Horticulture
Subject : Submission of a manuscript
NOTE : 11 files are attached (1 text + 10 figures)
Dear Dr R.P. Srivastava,
We wish to submit our manuscript entitled “Increasing Yield and Quality of Citrus by Pruning and Fertilization” for review and possible inclusion in Journal of Applied

Horticulture. We wish to state that there are no conflicts of interest and that this manuscript, in
part or in whole, has not been submitted elsewhere nor is being considered simultaneously by any other journal for publication. It has been formatted to suit the style of Journal of Applied Horticulture. In this manuscript, we investigated some pruning intensities and fertilization doses
to increase the yield and quality of citrus. We know that these cultivation tehcniques determine
the balance between sink and source. The main findings were 1) increasing doses of N, P, and K
fertilizers from 0 to 4% increased fruit set, harvested fruis, fruit size; content of vitamin C, sugar,
and soluble solid, 2) the highest value of fruit set, weight of harvested fruits, and content of vitamin C were achieved by pruning intensity of 8.37, 8.83, and 8.54%, respectively. These findings show that yield and quality of citrus can be increased by application of the appropriate
pruning intensity and fertilization dose.
Sincerely,
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Email Address of Corresponding Author:
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to Jaime

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Sakhidin

Purwokerto, Central Java, Indonesia

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Authors: Sakhidin Sakhidin,Jaime A. Teixeira da Silva,Anung Slamet Dwi Purwantono,Slamet Rohadi Suparto

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