

不同负载量对新新2核桃树体营养、生长及果实品质的影响

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摘要:【目的】探讨不同负载量处理对新新2核桃树体营养、生长及果实品质的影响,为其适宜的负载量提供理论依据。【方法】按照复叶与果实个数的比例设定5组不同负载量处理,测定不同负载量处理下对新新2核桃叶片、新枝、根系N、P、K含量及总糖营养、生长及果实品质的影响。【结果】随新新2果实负载量逐渐减小,叶片P、K含量相应升高,N含量、叶面积、百叶干、鲜质量均在复叶与果实比例为4:1处理时达到峰值,分别比CK提高了9.48%、49.54%、23.48%、14.13%,而叶片长宽比值及百叶干、鲜质量比值无显著差异。新梢生长量,N、P、K含量及总糖含量均随负载量的减小而增大。降低负载量可显著提高新新2单果质量、出仁率、蛋白质及维生素E含量,而果实脂肪含量却逐渐降低,各处理间核桃仁质量差异并不显著。新新2根系年生长量和N、P、K含量及总糖含量均随着负载量的减小而呈逐渐增大的趋势,并在复叶与果实比例4:1时达到最大值。【结论】综合新新2果实品质及树体营养等方面的因素,复叶与果实比例4:1为新新2核桃适宜负载量。

关键词:核桃;新新2;负载量;营养;生长量;果实品质

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Effects of loading capacity on tree nutrition, growth and fruit quality in Xinxin 2 walnut

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Abstract:【Objective】This experiment was conducted to study the effects of different ratios of compound leaves to fruits on the nutritional storage and fruit quality of Xinxin 2 walnut. The aim was to explore the suitable loading capacity of Xinxin 2 walnut variety in production, and to provide theoretical basis for efficient and high-yield cultivation of Xinxin 2 walnut. 【Methods】Five treatments were set according to the ratio of the number of compound leaves to the number of fruits on the fruiting branches (1:1, 2:1, 3:1, 4:1 and 5:1). At the same time, the CK (control) was set. The fruit and compound leaves of the whole walnut tree were extirpated according to different loading capacity settings. The changes of N, P, K nutrient storage in leaves, current shoots and root system and fruit quality were measured under different loading capacity. 【Results】The results showed that with the decrease of fruit loading capacity, the leaf P and K mass fractions increased correspondingly. At the same time, the leaf P and K mass fractions with the treatment of 5:1 were all significantly higher than those of other treatments, which reached 2.48 g·kg⁻¹ and 13.30 g·kg⁻¹, respectively. The N mass fraction, leaf area, and dry and fresh weight per 100 leaves reached the peak value when the ratio of compound leaves to fruit was 4:1, which were 9.48%, 49.54%, 23.48% and 14.13% higher than those of CK, respectively. There was no significant difference in leaf chlorophyll contents among 4:1, 3:1, 5:1 and 2:1 treatments, but they

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were all significantly higher than CK and 1:1 treatment. However, with the decrease of fruit loading capacity, there was no significant difference in the ratio of length to width and the ratio of dry weight to fresh weight per 100 leaves. The annual growth, N, P and K mass fractions and total polysaccharide content in current shoots all gradually increased with the decrease of loading capacity. And the annual growth of current shoots reached 9.40 cm and 9.34 cm with 4:1 and 5:1 treatments, which were 31.28% and 30.45% higher than those of CK, respectively, and there was no significant difference between the two treatments. The P mass fractions with 4:1 and 5:1 treatments were not significantly different. The N mass fraction ($11.20 \text{ g} \cdot \text{kg}^{-1}$), K mass fraction ($5.45 \text{ g} \cdot \text{kg}^{-1}$) and total polysaccharide content ($82.00 \text{ g} \cdot \text{kg}^{-1}$) in current shoots with 5:1 treatment were all significantly higher than those with other treatments. The results showed that the single fruit weight, kernel percent, protein and vitamin E contents significantly increased with reducing the loading capacity. The single fruit weight increased by 21.62%, the protein increased by 9.64%, and the vitamin E content increased by 11.11%, compared to CK. However, the fat content in nuts decreased gradually with the decrease of loading capacity, and there was a positive correlation between them. With the change of loading capacity, the quality of walnut kernel was not significantly different among the treatments. The root trait was affected significantly by different ratios of compound leaves to fruits. The annual root growth, N, P and K mass fractions and invert sugar content in new roots all increased gradually with the decrease of loading capacity, and reached the maximum when the ratio of compound leaves to fruit achieved 4:1. At the same time, the annual root growth per cubic meter reached 89.06 cm, the N mass fraction reached $12.40 \text{ g} \cdot \text{kg}^{-1}$, the P mass fraction reached $1.74 \text{ g} \cdot \text{kg}^{-1}$, the K mass fraction reached $3.88 \text{ g} \cdot \text{kg}^{-1}$, and the total polysaccharide content reached $90.00 \text{ g} \cdot \text{kg}^{-1}$, which were 19.02%, 49.40%, 89.13%, 12.14% and 21.62% higher than those with CK, respectively.【Conclusion】The N, P and K mass fractions and total polysaccharide content in new root and current shoots all increased gradually with the decrease of loading capacity. Considering the factors of fruit quality and nutritional storage balance, the tree nutritional status and fruit quality of Xinxin 2 walnut were better when the ratio of compound leaves to fruit was adjusted to 4:1, which could be regarded as the suitable loading capacity of Xinxin 2 walnut in production.

Key words: Walnut; Xinxin 2; Loading capacity; Nutrition; Growth; Fruit quality

果树的负载量的合理性与果树的产量、果实品质之间存在相辅相成、密不可分的关系^[1]。合理的负载量能打破树体树上和树下原有的平衡关系^[2],在确定某地最佳负载量时,既要保证当年果实的品质、产量及经济效益,又要保证不影响翌年的正常花果量,并且要能维持树势健壮,做到可持续生产^[3]。负载量过高,影响树体营养生长,使树势衰弱,病害发生较严重,叶片易老化^[4],同时延缓果实成熟,造成植株翌年新梢萌芽率较低和花芽质量较差^[5]。降低负载量可以显著提高果实纵径、果实横径和单果质量,并能显著降低果实硬度^[6],但株产量会显著降低^[7]。研究表明,随着负载量的降低,植株叶片的光合能力及进入叶片的CO₂的同化能力增加,叶面积、叶绿素含量、叶片中N、P、K含量及果实的可溶性固形物含量均显著增加^[8-13],同时枝条和根系贮存的氮

素、碳素营养含量呈升高趋势^[14]。

核桃(*Juglans regia* L.)在新疆的栽培历史由来已久,截至2019年,新疆核桃栽培面积达 $3.89 \times 10^5 \text{ hm}^2$,产量达 $1.01 \times 10^6 \text{ t}$,占新疆干果总产量的81.23%^[15]。同时,我国云南、新疆、陕西和四川省、区核桃产量之和占我国核桃总产量的80%以上^[16]。新新2核桃果实具有壳面光滑、美观,缝合线窄而平,果仁色浅、饱满,易取整仁,适应性、丰产性强等优势^[17],在市场上受到广泛欢迎,给当地果农带来较好的经济收益,成为目前新疆两大主栽核桃品种之一。近年来核桃种植户为追求产量最大化,造成新新2核桃在生产中结果量大,但单果质量偏小,空壳、瘪壳、露仁比例增加,树势减弱,植株发病率高,大小年发生普遍等现象。通过研究新新2核桃不同复叶与果实比例处理对叶片、新枝、根系N、P、K营养含量、生长性状及果

实品质的影响,探讨新新2在生产中适宜的负载量,为其高效栽培提供理论依据。

1 材料和方法

1.1 材料

试验地位于新疆阿克苏地区温宿县木本粮油林场境内,试验点布置在新疆林业科学院良种核桃示范园内($41^{\circ}19'50.7''N, 80^{\circ}13'33.2''E$)。试验地土壤质地适中,主要为壤砂土,以大水漫灌为主。所属区域降水量稀少,蒸发量大,昼夜温差悬殊,年均气温 $10.1^{\circ}C$,年均降水量 65.4 mm ,年均蒸发量 956.3 mm ,属典型的大陆性气候。连续3 a(年)(2018、2019、2020年)对新新2核桃品种进行负载量试验,所选树龄18 a,株行距为 $5\text{ m} \times 6\text{ m}$,供试树体健壮、无病虫害,树冠($5.90\sim6.20\text{ m} \times (5.75\sim6.16\text{ m})$,树高($6.03\sim6.46\text{ m}$,以开心形树形为主,单株干果产量维持在 $10\sim12\text{ kg}$,常规管理。

1.2 方法

1.2.1 负载量设置 按结果枝上复叶个数与果实个数的比例设定5个处理,同时将不处理的结果枝设定为对照(CK)。4月下旬坐果期,按照不同负载量设置对整株核桃树进行疏花果、疏复叶,每处理3株树,3次重复。负载量处理如表1所示。

表1 不同复叶与果实比例处理下负载量

Table 1 The Loading capacity under different ratios of compound leaves to fruits

处理方式 Treatment method	复叶:果实 Compound leaves: Fruits
处理 I Treatment I	1:1
处理 II Treatment II	2:1
处理 III Treatment III	3:1
处理 IV Treatment IV	4:1
处理 V Treatment V	5:1
对照 CK	1.86:1.00

1.2.2 形态指标测定 8月中旬,对不同负载量处理下1年生枝条的新梢生长量、叶面积及百叶鲜、干质量等指标进行测定。9月底果实采收晾干后,测定各处理的单株产量、单果质量、仁质量、出仁率等指标。

1.2.3 生理指标测定 8月中旬,对不同负载量处理下叶片N、P、K含量及叶绿素含量进行测定。9月下旬对果实蛋白质、脂肪、维生素E含量进行测定。11月下旬,对休眠期枝条和根系的N、P、K含量及总糖含量进行测定。根系年生产量借助根窖法进行观

察测定。

利用PinAAcle 900F火焰原子吸收分光光度计测定N、P、K含量(分别根据LY/T 1269—1999、LY/T 1270—1999、LY/T 1270—1999),利用8400型全自动凯氏定氮仪测定蛋白质含量(GB 5009.5—2016),利用DHG-9038A型电热恒温鼓风干燥箱测定脂肪含量(GB 5009.6—2016)、利用Waters e 2695高效液相色谱仪测定维生素E含量(GB 5009.82—2016),利用滴定法测定总糖含量(GB 5008.5—2016),利用SPAD-502 plus测定叶绿素含量,利用Yaxin-1242叶面积仪测定叶片面积、周长等。

1.3 数据分析

使用Excel 2007和SPSS 24.0软件对试验数据进行处理分析。

2 结果与分析

2.1 不同负载量处理对叶片营养含量及性状的影响

不同复叶与果实比例处理对新新2叶片营养含量产生显著影响。如表2所示,在复叶与果实比例为4:1处理下,新新2叶片N质量分数达到 $25.40\text{ g}\cdot\text{kg}^{-1}$,比CK高出9.48%,均显著高于其余处理。随着负载量的逐渐减小,新新2叶片P质量分数逐渐升高,在5:1处理下达到 $2.48\text{ g}\cdot\text{kg}^{-1}$,显著高于其余处理。在3:1和4:1处理下,叶片P质量分数无显著差异,但均显著高于1:1、2:1及CK。新新2叶片K质量分数随负载量的减小而逐渐增大,呈反比关系,在5:1处理下达到最大值,显著高于其余处理。在4:1处理下叶片K质量分数显著高于1:1、2:1、3:1和CK。在2:1、3:1、4:1、5:1处理间新新2叶片叶绿素含量无显著

表2 不同负载量处理对新新2叶片营养含量的影响

Table 2 Effects of different loading capacity on leaf nutrient content of Xinxin 2

处理 Treatment	$w(N)/(\text{g}\cdot\text{kg}^{-1})$	$w(P)/(\text{g}\cdot\text{kg}^{-1})$	$w(K)/(\text{g}\cdot\text{kg}^{-1})$	SPAD
1:1	$19.40\pm0.05\text{ e}$	$0.88\pm0.01\text{ e}$	$8.50\pm0.06\text{ d}$	$47.22\pm0.98\text{ c}$
2:1	$20.90\pm0.07\text{ d}$	$1.38\pm0.00\text{ d}$	$9.90\pm0.07\text{ c}$	$53.75\pm0.46\text{ a}$
3:1	$21.10\pm0.26\text{ d}$	$1.60\pm0.01\text{ b}$	$10.10\pm0.10\text{ c}$	$53.67\pm0.62\text{ a}$
4:1	$25.40\pm0.06\text{ a}$	$1.62\pm0.01\text{ b}$	$10.40\pm0.05\text{ b}$	$54.72\pm0.45\text{ a}$
5:1	$24.50\pm0.11\text{ b}$	$2.48\pm0.02\text{ a}$	$13.30\pm0.04\text{ a}$	$53.35\pm0.24\text{ a}$
CK	$23.20\pm0.05\text{ c}$	$1.51\pm0.01\text{ c}$	$10.00\pm0.08\text{ c}$	$51.43\pm0.83\text{ b}$

注:不同小写字母表示差异显著($p < 0.05$)。下同。

Note: Different small letters indicate significant difference at the 0.05 level. The same below.

差异,但均显著高于1:1及CK。

新新2在复叶与果实比例为4:1处理下,单叶面积可达到158.17 cm²,显著高于其余处理,高出CK 49.54%,而CK与1:1、2:1处理均无显著差异。在复叶与果实比例为3:1处理下,新新2单叶片周长达到

最长,为112.10 cm,而在1:1、4:1、5:1及CK四组处理间无显著差异。新新2单叶片长宽比在6组处理间均无显著差异(表3)。新新2叶片百叶鲜质量、干质量在4:1处理下达到最高值,分别为291.77、111.39 g,均显著高于其余处理。但在不同负载量处

表3 不同负载量处理对新新2叶片性状的影响

Table 3 Effects of different loading capacity on leaf trait of Xinxin 2

处理 Treatment	面积 Area/cm ²	周长 Perimeter/cm	长宽比 Length-Width ratio	百叶鲜质量 Shutter fresh weight/g	百叶干质量 Shutter dry weight/g	干鲜叶比率 Dry-fresh leaf ratio/%
1:1	101.44±3.49 d	83.03±4.66 c	1.39±0.09 a	212.71±4.27 d	74.03±3.18 c	34.88±0.97 a
2:1	109.61±2.98 d	97.70±2.60 b	1.40±0.04 a	236.48±5.52 c	85.15±3.46 bc	35.50±1.47 a
3:1	122.90±2.82 c	112.10±5.63 a	1.41±0.03 a	263.38±6.29 b	96.95±5.24 b	36.82±1.85 a
4:1	158.17±4.41 a	89.23±4.47 bc	1.43±0.05 a	291.77±6.12 a	111.39±4.65 a	38.21±1.68 a
5:1	139.50±4.01 b	77.61±4.48 c	1.43±0.05 a	252.89±5.66 b	96.14±3.49 b	38.02±0.88 a
CK	105.77±3.87 d	79.90±3.19 c	1.42±0.03 a	255.65±5.09 b	90.21±3.49 b	35.30±1.42 a

理中,新新2叶片干鲜叶比率无显著差异。

2.2 不同负载量处理对新梢性状的影响

新新2新梢长度随着负载量的减小而逐渐增大,当复叶与果实比例达到4:1及5:1时,新梢长度达到最大,平均值为9.40、9.34 cm,分别高于CK 31.28%和30.45%,两处理间无显著差异。新新2新梢着生的雌花芽数、雄花芽数及第2年坐果数在5:1处理下均显著高于1:1处理,分别高出73.22%、50%、69.71%,但均与其余处理无显著差异。随着负

载量的逐渐减小,新新2新梢N质量分数随之增加,呈反比。当复叶与果实比例达到5:1时,新梢N质量分数达到11.20 g·kg⁻¹,显著高于其余处理。在不同处理下,新梢N质量分数依次为5:1>4:1>3:1>2:1>CK>1:1,各处理之间均存在显著差异(表4)。新梢P质量分数在4:1及5:1处理时达到最高,两处理间无显著差异,但均显著高于其余处理。新梢K质量分数随着负载量的减小而逐渐增大,在5:1处理下达到最高,比CK高出28.84%。新梢总糖

表4 不同负载量处理对新新2新梢性状的影响

Table 4 Effects of different loading capacity on new branches trait of Xinxin 2

处理 Treatment	长度 Growth length/cm	雌花芽数 The number of female bud	雄花芽数 The number of male bud	坐果数 Fruit set percentage	w(N)/(g·kg ⁻¹)	w(P)/(g·kg ⁻¹)	w(K)/(g·kg ⁻¹)	w(总糖) Total sugar content/(g·kg ⁻¹)
1:1	7.78±0.24 c	1.83±0.31 b	4.00±0.58 b	3.83±0.48 b	6.90±0.06 f	0.59±0.03 e	3.55±0.11 e	42.00±0.40 d
2:1	8.57±0.18 b	2.17±0.31 ab	4.83±0.60 ab	4.83±0.65 ab	9.00±0.09 d	0.85±0.02 d	4.19±0.09 d	59.50±1.00 c
3:1	8.67±0.21 b	2.67±0.33 ab	5.17±0.48 ab	5.50±0.76 ab	9.80±0.07 c	1.07±0.02 b	4.58±0.11 c	66.00±0.50 b
4:1	9.40±0.26 a	2.83±0.31 ab	5.56±0.42 ab	5.67±0.71 ab	10.20±0.06 b	1.41±0.04 a	5.14±0.15 b	67.00±0.40 b
5:1	9.34±0.18 a	3.17±0.31 a	6.00±0.68 a	6.50±0.72 a	11.20±0.06 a	1.46±0.01 a	5.45±0.10 a	82.00±0.50 a
CK	7.16±0.20 d	2.33±0.33 ab	4.67±0.33 ab	4.67±0.56 ab	8.00±0.07 e	0.94±0.05 c	4.23±0.08 d	66.00±0.50 b

质量分数在5:1处理下达到82.00 g·kg⁻¹,显著高于其余处理,而在3:1、4:1及CK三组处理间无显著差异,但均显著高于1:1和2:1处理。

2.3 不同负载量处理对果实品质性状的影响

由表5可知,在复叶与果实比例为3:1时,果实纵径达到4.25 cm,与2:1和4:1处理间无显著差异,但显著高于其余处理。在2:1、3:1、4:1处理下,新新2单果质量达到最大值,为12.60~12.84 g,高出

CK 21.62%~23.94%,3组处理间无显著差异。除CK外,不同负载量处理中,新新2仁质量均无显著差异。在4:1处理下果壳厚度显著大于1:1及CK,但均与其余处理无显著差异。复叶与果实比例4:1及5:1下,新新2露仁率最低,两处理间无显著差异,但均显著低于其余处理。在5:1处理下新新2出仁率均显著高于2:1、3:1和4:1三组处理。CK处理下核桃单株产量达到11.25 kg,与1:1、2:1、3:1及4:1处

表5 不同负载量处理对新新2果实品质性状的影响

Table 5 Effects of different loading capacity on fruit quality trait of Xinxin 2

处理 Treatment	纵径 Vertical diameter/cm	横径 Transverse diameter/cm	侧径 Side diameter/cm	单果质量 Fruit weight/g	仁质量 Kernel weight/g	壳厚 Shell thickness/mm
1:1	4.06±0.04 c	3.29±0.04 a	3.44±0.05 a	11.53±0.28 b	7.04±0.16 ab	0.91±0.01 b
2:1	4.14±0.04 abc	3.19±0.02 b	3.45±0.05 a	12.84±0.23 a	7.48±0.06 a	0.93±0.04 ab
3:1	4.25±0.04 a	3.30±0.04 a	3.50±0.04 a	12.81±0.27 a	7.35±0.23 a	0.98±0.04 ab
4:1	4.20±0.02 ab	3.23±0.03 ab	3.37±0.04 ab	12.60±0.24 a	7.17±0.14 ab	1.04±0.02 a
5:1	4.11±0.03 bc	3.23±0.04 ab	3.37±0.04 ab	11.80±0.19 b	7.44±0.22 a	1.01±0.06 ab
CK	4.06±0.04 c	3.18±0.01 b	3.29±0.05 b	10.36±0.21 c	6.73±0.15 b	0.96±0.02 b
处理 Treatment	露仁率 Exposed kernel rate/%	出仁率 Kernel percent/%	单株产量 Single plant yield/kg	w(蛋白质) Protein content/ (g·kg ⁻¹)	w(脂肪) Fat content/ (g·kg ⁻¹)	w(维生素E) Vitamin E content/ (mg·kg ⁻¹)
1:1	20.42±1.35 a	61.12±1.17 ab	10.84±0.62 ab	139.00±1.00 d	677.80±1.60 a	74.40±0.10 e
2:1	17.68±0.89 b	58.33±1.34 b	12.81±1.04 a	160.00±0.50 c	655.00±4.40 b	79.40±0.30 d
3:1	12.75±0.82 c	57.35±1.28 b	11.26±0.74 ab	180.00±1.20 a	645.00±1.10 c	95.40±1.80 b
4:1	7.38±0.66 d	56.97±1.30 b	9.12±0.37 bc	182.00±0.90 a	644.00±4.20 c	101.00±0.50 a
5:1	7.42±0.63 d	63.22±1.54 a	8.55±0.70 c	180.00±0.90 a	625.00±3.20 d	100.00±0.30 a
CK	19.08±0.81 ab	65.03±1.41 a	11.26±0.51 ab	166.00±0.60 b	646.00±2.20 c	90.90±0.10 c

理间均无显著差异,但显著高于5:1处理。新新2果实蛋白质质量分数随着负载量的减小而不断增高,其中在4:1处理中蛋白质质量分数达到最大值($182.00\text{ g}\cdot\text{kg}^{-1}$),比CK处理高出9.64%,但与3:1及5:1处理均无显著差异。同时1:1处理下果实蛋白质质量分数最低,均显著低于其余5组处理。新新2果实脂肪质量分数随着负载量的减小而逐渐减小,呈正相关。脂肪质量分数在1:1处理下最高,达到 $677.80\text{ g}\cdot\text{kg}^{-1}$,显著高于其余5组处理。新新2果实维生素E质量分数随着负载量的不断减小而增加,在4:1和5:1处理中达到最高,两处理间无显著差异,但均显著高于1:1、2:1、3:1和CK。CK处理下果实维生素E质量分数显著高于1:1及2:1处理。

2.4 不同负载量处理对根系性状的影响

不同负载量处理可对新新2根系生长产生显著影响,随着负载量的逐渐减小,新新2根系生长量呈

现递增的趋势。如表6所示,当复叶与果实比例为4:1时,新新2土壤根系年生长量可达到 89.06 cm ,显著高于1:1、2:1及CK,但与5:1处理无显著差异。CK处理下土壤根系年生长量为 $74.83\text{ cm}\cdot\text{m}^{-3}$,显著高于1:1、2:1处理。新新2根系N质量分数随着负载量的减小呈现先增后降的趋势,在4:1处理下达到最大值($12.40\text{ g}\cdot\text{kg}^{-1}$),高出CK 49.40%。6组处理中新新2根系N质量分数均存在显著差异,大小依次为4:1>3:1>5:1>2:1>CK>1:1。新新2根系P质量分数在复叶与果实比例为4:1处理下达到最大值($1.74\text{ g}\cdot\text{kg}^{-1}$),比CK($0.92\text{ g}\cdot\text{kg}^{-1}$)提高了89.13%,均显著高于其余5组处理。根系K质量分数随负载量的减小而逐渐增高,在4:1及5:1处理下达到最高值。在4:1处理下新新2根系总糖质量分数最大,达到 $90.00\text{ g}\cdot\text{kg}^{-1}$,比CK高出21.62%,均显著高于其余5组处理。而5:1处理下根系总糖质量分数亦显著高于1:1、2:1、3:1和CK。

表6 不同负载量处理对新新2根系性状的影响

Table 6 Effects of different loading capacity on root trait of Xinxin 2

处理 Treatment	生长量 Growth length/cm	w(N)/(g·kg ⁻¹)	w(P)/(g·kg ⁻¹)	w(K)/(g·kg ⁻¹)	w(总糖) Total sugar content/(g·kg ⁻¹)
1:1	61.17±3.24 c	7.70±0.04 f	0.74±0.01 e	2.92±0.05 d	65.00±0.70 e
2:1	61.71±2.84 c	8.68±0.04 d	1.13±0.01 c	3.44±0.02 c	75.00±0.60 c
3:1	71.06±3.00 bc	11.22±0.41 b	1.12±0.01 c	3.62±0.05 b	73.00±0.60 d
4:1	89.06±4.87 a	12.40±0.16 a	1.74±0.01 a	3.88±0.03 a	90.00±0.30 a
5:1	81.65±4.95 ab	10.90±0.10 c	1.36±0.02 b	3.80±0.04 a	82.00±0.50 b
CK	74.83±3.90 b	8.30±0.07 e	0.92±0.01 d	3.46±0.04 c	74.00±0.30 cd

3 讨 论

随着负载量的逐渐减小,新新2叶片P、K含量逐渐升高,而N含量在复叶与果实比例为4:1处理时达到最高,与施明等^[10]对赤霞珠葡萄叶片的研究结论相似,然而盛果期红富士叶片N、P、K含量随负载量不同差异均不显著^[18]。新新2核桃在高负载量处理下叶片叶绿素含量偏低,而在低负载量几组处理间叶绿素含量差异并不显著。但也有研究认为,随着负载量增大,叶片叶绿素含量呈下降趋势^[19-20],与本试验既有相似又有不同,主要原因可能是品种特性、立地栽培条件、管理水平间的差异所致。随着负载量的减小,新新2叶面积逐渐增大,在复叶与果实比例为4:1处理时达到最大,叶片周长表现为先增后降的趋势,而长宽比则在不同负载量处理间无显著差异。这与薛晓敏等^[19]在红富士上得出的结论一致,丁宁等^[9]同样认为中负载量和低负载量苹果的叶面积比高负载量显著增加。新新2叶片百叶干质量、鲜质量均随着负载量的减小而逐渐增加,在4:1处理时达到峰值,随后降低,而干鲜叶比值在各处理间无显著差异。新新2新梢生长量随着负载量的减小而逐渐增大,主要是果实负载量过高强烈地抑制了新梢的生长^[14]。随着负载量的减小,新新2核桃新梢N、P、K及总糖含量均表现出递增的趋势,说明适当降低负载量可显著提高树体的营养水平,促使植株营养生长和生殖生长的均衡协调^[2,21],与施明等^[10]、袁成龙等^[14]的研究结论一致,但路超等^[18]研究认为盛果期红富士苹果的枝条和叶片在不同负载量处理下N、P、K含量差异均不显著。

随着负载量的增大,单果质量逐渐降低,严重影响了果实的品质和商品率^[19, 22-23]。试验中适宜的负载量可促使新新2核桃单果质量的显著增加,同时露仁率显著降低,而对提高仁质量效果并不显著,说明适宜的负载量有助于核桃壳的发育,显著降低了露仁核桃在生产中的比率,提高了新新2核桃单果质量和优质果率,与张建英等^[24]对西岭核桃的研究结论一致。随着新新2负载量的逐渐减小,核桃坚果蛋白质及维生素E含量呈升高趋势,而脂肪含量逐渐降低,进一步提高了核桃品质。果树负载能力体现在光合产物的生产、积累和果实的消耗,合理的负载能力使三者之间形成一种动态平衡^[20]。核桃树体负载量过大,树体营养消耗过多,果实生长发育不

正常^[24],同时强烈地抑制了根的生长,使根系第2次生长高峰明显减弱,第3次生长高峰消失^[14]。在一定范围内,新新2核桃根系年生长量、新根N、P、K及总糖含量均随着负载量的逐渐减小而呈现升高的趋势,说明适宜的负载量处理可促使树体生殖生长向营养生长的转换,同时可促进根系对N、P、K及总糖等营养成分的贮藏,进而满足第2年新新2树体萌芽、展叶及花期生长发育所需养分,确保新新2核桃植株丰产、稳产。

4 结 论

综合新新2果实品质、树体发育性状及营养等方面的考虑,生产中复叶与果实比例4:1为新新2核桃适宜负载量。

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