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Integrated fertilizer prescriptions for bhendi through inductive cum targeted yield model in Bahour soil series (*Typic ustropept*) of Puducherry

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Abstract
The field experiments were conducted on a *Typic ustropept* soils of Puducherry by adopting the inductive cum targeted yield model, and fertiliser requirements were quantified for bhendi based on soil test and yield target. The basic parameters *viz.* nutrient requirement (NR), contribution of nutrients from soil (Cs), fertilizer (Cf) and farmyard manure (Cfym) were computed from field experimental data. Using these basic parameters, the fertiliser prescription equations were developed under integrated plant nutrition system (IPNS) and nomograms were formulated for the desired yield target of bhendi for a range of soil test values. The quantity of fertilizers that could be contributed by FYM @ 12.5 t ha^{-1} for bhendi were evaluated as 50, 28 and 43 kg fertilizer N, P_2O_5 and K_2O respectively, when applied along with the NPK fertilizers as per soil test and desired yield target.

Keywords: Bhendi, fertiliser prescription equation and IPNS

Introduction
The demand for high-value commodities (such as horticulture, dairy, livestock and fish) is increasing faster than food grains and for most of the high-value food commodities, demand is expected to increase by more than 100 per cent from 2000 to 2030 (ICAR, 2011) [5]. To meet the vegetable requirement for ever increasing population of our country, the best way is to produce more from limited land resources. Further, the escalation in fertiliser prices has caused a serious setback for balanced fertilization. Hence, exclusive dependence on either inorganic fertilizers or organic sources is neither economically viable nor environmentally acceptable.
Okra (*Abelmoschus esculentum* L.) is one of the important vegetable grown throughout the tropics and warm temperate zones. India is the largest producer of bhendi in the world with an area of 0.43 million hectare and a total production of 4.53 million tonnes. The average productivity of bhendi in India is 10.5 t ha^{-1} as against world's productivity of 6.6 t ha^{-1} (Varmudy, 2011) [24]. Bhendi is also an important crop of Tamil Nadu and Puducherry and produced 56,800 t and 1,000 t annually from Tamil Nadu and Puducherry respectively. (INDIASTAT, 2014-15). Okra fruit is good source vitamin A, B and C. The content of calcium in its fruits is very high (66 mg/100g of edible portion) compared to that of other fruit vegetables. It is an excellent source of iodine. It is also rich in protein and mineral nutrients. Among fruit vegetables, okra fruits have good demand of throughout the year.
The present consumption of vegetables per capita per day is 135 g against the requirement of 285 g per capita per day emphasizing the necessity to enhance production of vegetables which can be achieved by bringing more land under vegetables cultivation and increasing the productivity of the vegetables as well.
At this juncture, the prescription procedure outlined by Truog (1960) [22] and modified by Ramamoorthy *et al.* (1967) [12] as Inductive cum Targeted yield model strikes a balance between 'fertilizing the crop' and 'fertilizing the soil'. This model provides a scientific basis for balanced fertilization and balance between applied nutrients and soil available nutrients.

Materials and Methods
The present study consisted of two field experiments in two phases *viz.*, fertility gradient experiment with Hybrid maize (Kavery super 244) (Phase I) and the test crop experiment with Hybrid Bhendi (Green Gold Plus) (phase II). The experiments were conducted during 2017-2018 on Bahour soil series (*Typic Ustropept*) at farmer's holding of Karikalampakkam

village in U.T of Puducherry. The study area comes under coastal alluvial plain (PC1) classified as fine, mixed isohyperthermic, *Typic Ustropept* with an area of 12.72 per cent. According to agro climatic zonal classification, the study area is located at 11°56' North latitude and 79°66'East longitude.

The surface soil (0 - 15 cm deep) of the experimental field is sandy clay loam in texture. The pH, electrical conductivity and cation exchange capacity of the soil were 7.95, 0.81 dS m^{-1} and 36.5 c mol (p^+) kg^{-1}, respectively. The initial soil available alkaline potassium permanganate ($KMnO_4$) nitrogen (N), Olsen phosphorus (P) and ammonium acetate (NH_4OAc) potassium (K) were 187.2 kg ha^{-1}, 64.42 kg ha^{-1} and 230 kg ha^{-1}, respectively. The P and K fixing capacities of the soil were 150 and 100 kg ha^{-1} respectively.

In gradient experiments, the variation in soil fertility was created by adopting the Inductive Methodology developed by Ramamoorthy *et al*. (1967) [12]. For this purpose, the experimental field was divided into three equal strips, the first strip received no fertilizer ($N_0P_0K_0$), the second and third strips received one ($N_1P_1K_1$) and two ($N_2P_2K_2$) times the standard dose of N, P_2O_5 and K_2O respectively and a gradient crops of Hybrid maize (Kavery super 244) was grown. The pre-sowing and post-harvest soil samples from each fertility strips were collected thus making a total of 24 samples and analysed for alkaline $KMnO_4$-N, Olsen -P and NH_4OAc-K.

After the harvest of Hybrid maize, each strip was divided into 24 plots, and pre-sowing soil samples were collected from each plots and analysed for alkaline $KMnO_4$-N (Subbiah and Asija, 1956), Olsen -P (Olsen *et al.*1954) and NH4OAc-K (Stanford and English, 1949). The experiment was laid out in a fractional factorial design comprising twenty four treatments each for, the treatments consisted of four levels of N, *viz*., 0, 100, 200 and 300 kg ha^{-1} and P_2O_5 and K_2O *viz*., 0, 50. 100, and 150 kg ha^{-1} respectively and three levels of FYM (0, 6.25 and 12.5 t ha^{-1}). The IPNS treatments (NPK alone, FYM @ 6.25 t ha^{-1} and 12.5 t ha^{-1}) were superimposed across the strips. There were 21 fertilizer treatments along with three controls which were randomized in each strip in such a way that all the treatments occurred in both directions (Table 1). The test crop Bhendi was sown with a spacing of 45 cm x 30 cm. After sowing routine cultural operations were followed periodically. The crop was grown to maturity, harvested and plot wise yields were recoded. The fruit, plant and post-harvest soil samples were collected from each plot and processed and analysed for N (Humphries 1956), P and K contents (Jackson 1973), and NPK uptake by Bhendi was computed using the dry mater yield.

Making use of data on the yield of Bhendi, total uptake of N, P and K, initial soil test values for available N, P and K and doses of fertilizer N, P_2O_5 and K_2O applied, the basic parameters *viz*., nutrient requirement (NR), contribution of nutrients from soil (Cs), fertilizer (Cf) and farmyard manure (Cfym) were calculated as outlined by Ramamoorthy *et al.* (1967) [12].

Nutrient requirement (NR) kg q^{-1}

$$\text{Kg N/ } P_2O_5\text{/ } K_2O \text{ required per quintal of bhendi fruit production} = \frac{\text{Total uptake of N/ } P_2O_5\text{/ } K_2O \text{ (kg ha}^{-1})}{\text{bhendi fruit yield (q ha}^{-1})}$$

Per cent nutrient contribution of nutrients from soil to total nutrient uptake (Cs)

$$\text{Per cent contribution of N/ } P_2O_5\text{/ } K_2O \text{ from soil} = \frac{\text{Total uptake of N/ } P_2O_5\text{/ } K_2O \text{ in control plot (kg ha}^{-})}{\text{Soil test value for available N/ } P_2O_5\text{/ } K_2O \text{ in control plot (kg ha}^{-1})} \text{ x } 100$$

Per cent nutrient contribution of nutrients from fertilizer to total uptake (Cf)

$$\text{Per cent contribution of N/ } P_2O_5\text{/ } K_2O \text{ from fertilizer} = \frac{\text{Total uptake of N/ } P_2O_5\text{/ } K_2O \text{ in treated plot (kg ha}^{-1}) - \left(\text{Soil test value for available N/ } P_2O_5\text{/ } K_2O \text{ in treated plot (kg ha}^{-1}) \text{ x Average Cs}\right)}{\text{Fertilizer N/ } P_2O_5\text{/ } K_2O \text{ applied (kg ha}^{-1})} \text{ x } 100$$

Percent nutrient contribution of nutrients from organics to total uptake (Co)
Percent contribution from FYM (Cfym)

$$\text{Percent contribution of N/P/K from FYM} = \frac{\text{Total uptake of N/P/K in FYM treated plot (kg ha}^{-1}) - \left(\text{Soil test value for available N/P/K in FYM treated plot (kg ha}^{-1}) \text{ x Average Cs}\right)}{\text{Nutrient N/P/K added through FYM (kg ha}^{-1})} \text{ x } 100$$

These parameters were used for developing fertilizer prescription equations for deriving fertilizers doses, and the soil test based fertiliser recommendations were prescribed in the form of a ready table for desired yield target of Bhendi under NPK alone as well as under IPNS.

Table 1: Treatment structure for bhendi

Sl. No	Treatment combinations			Levels of nutrients (kg ha^{-1})		
	N	P	K	N	P_2O_5	K_2O
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	2	2	0	100	100
5	1	1	1	100	50	50
6	1	2	1	100	100	50
7	1	1	2	100	50	100
8	1	2	2	100	100	100
9	2	1	1	200	50	50
10	2	0	2	200	0	100
11	2	1	2	200	50	100
12	2	2	2	200	100	100
13	2	2	1	200	100	50
14	2	2	0	200	100	0
15	2	2	3	200	100	150
16	2	3	2	200	150	100
17	2	3	3	200	150	150
18	3	1	1	300	50	50
19	3	2	1	300	100	50
20	3	2	2	300	100	100
21	3	3	1	300	150	50
22	3	3	2	300	150	100
23	3	2	3	300	100	150
24	3	3	3	300	150	150

Table 2: Levels of fertilizer nutrients and FYM for bhendi

Level	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	FYM (t ha^{-1})
0	0	0	0	0
1	100	50	50	6.25
2	200	100	100	12.5
3	300	150	150	-

Targeted yield equations

Making use of these parameters, the fertilizer prescription equations (FPEs) were developed for Bhendi as furnished below.

1. Fertilizer nitrogen (FN)

$$FN = \frac{NR}{Cf/100} T - \frac{Cs}{Cf} SN$$

$$FN = \frac{NR}{Cf/100} T - \frac{Cs}{Cf} SN - \frac{Cfym}{C_f} ON$$

2. Fertilizer phosphorus (FP_2O_5)

$$FP_2O_5 = \frac{NR}{Cf/100} T - \frac{Cs}{Cf} \times 2.29 \times SP$$

$$FP_2O_5 = \frac{NR}{Cf/100} T - \frac{Cs}{Cf} \times 2.29 \times SP - \frac{Cfym}{C_f} \times 2.29 \times OP$$

3. Fertilizer potassium (FK_2O)

$$FK_2O = \frac{NR}{Cf/100} T - \frac{Cs}{Cf} \times 1.21 \times SK$$

$$FK_2O = \frac{NR}{Cf/100} T - \frac{Cs}{Cf} \times 1.21 \times SK - \frac{Cfym}{C_f} \times 1.21 \times OK$$

where, FN, FP_2O_5 and FK_2O are fertilizer N, P_2O_5 and K_2O in kg ha^{-1}, respectively; NR is Nutrient requirement N or P_2O_5 or and K_2O kg q^{-1}, Cs is Per cent nutrient contribution of nutrients from soil, Cf is Per cent nutrient contribution of nutrients from fertilizer, Cfym is Percent contribution from FYM, T is the yield target in q ha^{-1}; SN, SP and SK respectively are alkaline $KMnO_4$-N, Olsen-P and NH_4OAc-K in kg ha^{-1} and ON, OP and OK are the quantities of N, P and K supplied through FYM in kg ha^{-1}.

These equations serve as a basis for predicting fertilizer doses for specific yield targets (T) of hybrid Bhendi for varied soil available nutrient levels.

Table 3: Pre-sowing soil available NPK, yield and NPK uptake by bhendi in various strips (kg ha^{-1})

Parameters (kg ha^{-1})	Strip I		Strip II		Strip III	
	Range	Mean	Range	Mean	Range	Mean
$KMnO_4$ -N	142.8-165.2	158.3	198.8-226.8	212.4	215.8-252.0	235.1
Olsen–P	51.8-60.9	55.6	55.4-59.6	57.1	58.1-63.2	59.6
NH_4OAc-K	197-216	205	213-239	225	218-280	265
Fruit yield	7600-13850	10765	7815-16500	13181	8110-18300	14379
N uptake	22.4-88.3	71.7	23.8-108.7	79.9	24.8-109.3	81.1
P uptake	6.5-19.6	15.5	6.8-22.0	16.5	7.0-23.8	17.7
K uptake	21.3-90.2	61.0	22.2-106.8	78.7	25.1-124.6	84.1

Results and discussion

The range and mean of soil test values and yield of three strips are presented in table 3. Maximum yield (14379 kg ha^{-1}) was obtained in strip III and the lowest in the strip I (10765 kg ha^{-1}). The data on initial soil test values revealed that alkaline $KMnO_4$-N ranged from 142.8 to 165.2 kg ha $^{-1}$ with a mean value of 158.3 kg ha^{-1} in strip I, from 198.8 to 226.8 with a mean values of 212.4 kg ha^{-1} in strip II and from 215.8 to 252.0 kg ha^{-1} with a mean value of 235.1 kg ha^{-1} in strip III. The Olsen-P ranged from 51.8 to 60.9, 55.4 to 59.6 and 58.1 to 63.2 kg ha^{-1} respectively in strip I, II and III. The mean values of Olsen-P were 55.6, 57.1 and 59.6 kg ha^{-1} in strip I, II and III respectively. The range of NH_4OAc-K varied between 197 and 216 with mean values of 205 kg ha^{-1} in strip I, 213 and 239 with the mean value of 225 kg ha^{-1} in strip II and 218 and 280 with a mean value of 265 kg ha^{-1} in strip III. When the uptake of nutrients were concerned, the N uptake in strip I, II and III ranged respectively from 22.4 to 88.3, 23.8 to 108.7 and 24.8 to 109.3 with the mean values of 71.7, 79.9 and 81.1 kg ha^{-1}. The P uptake ranged from 6.5-19.6 kg ha^{-1} with a mean of 15.5 kg ha^{-1} in strip I, from 6.8 to 22.0 kg ha^{-1} with a mean of 16.5 kg ha^{-1} in strip II and from 7.0 to 23.8 kg ha^{-1} with a mean of 17.7 kg ha^{-1} in strip III. The K uptake ranged from 21.3 to 90.2, 22.2 to 106.8 and 25.1 to 124.6 kg ha^{-1} in strip I, II and III respectively. The mean K uptake values were 61.0, 78.7 and 84.1 kg ha^{-1} respectively in strip I, II and III. The above results showed that a wide variability existed in the soil test values, fruit yield and nutrient uptake, which is a pre-requisite for calculating the basic parameters and fertilizer prescription equations for calibrating the fertilizer doses for specific yield targets. Uma devi (2005) [23] and Coumaravel (2012) [2] reported similar existence of operational ranges of available N, P and K for carrot and Tomato on Ultisols and Alfisol respectively.

The result of the above findings was in conformity with findings of. Murugesa Boopathi,. (1995) [10] and Venkatakrishnan. (2016) [25] who also reported such increase in yield and uptake of nutrients by rice with increase in fertilizer levels. Furthermore, application of organic manures not only increased the supply of easily assimilated major nutrients to plants, besides mobilizing unavailable nutrients

into available form due to improvement in soil physio-chemical and biological properties by providing carbon and nitrogen source to micrbes, further it also increased the activity of soil enzymes (Singh *et al*., 2006) [18]

Basic parameters (Table 4)

In the targeted yield model, making use of data on the yield of bhendi, total uptake of N, P and K, initial soil test values for available N, P and K and doses of fertilizer N, P_2O_5 and K_2O applied, the basic parameters were computed. The basic parameter for developing fertilizer prescription equations for bhendi are nutrient requirement kg per quintal of bhendi (NR), contribution of available nutrients from soil (Cs), fertilizer nutrients (Cf) and farmyard manure (Cfym).

Table 4: Nutrient requirement, per cent contribution of nutrients from soil, fertilizer and FYM for bhendi

Crop	Parameters	Basic Data		
		N	P_2O_5	K_2O
Bhendi	Nutrient requirement (kg q^{-1})	0.60	0.29	0.71
	Per cent contribution from soil (Cs)	11.70	11.75	10.05
	Per cent contribution from fertilizers (Cf)	30.20	25.73	77.03
	Per cent contribution from FYM (Cfym)	33.78	11.41	41.08

Nutrient requirement

To produce one quintal of bhendi fruit 0.60 kg of N, 0.29 kg of P_2O_5 and 0.71 kg of K_2O were required. Among the three nutrients, the requirement of K_2O was the highest followed by N and P_2O_5. The requirement of K_2O was 1.18 times higher than N and 2.45 times higher than P_2O_5. Similar trend of nutrient requirement for N, P_2O_5 and K_2O was also reported by Muralidharudu *et al.* (2007 and 2011) [8-9] for tomato and Smitha John *et al*. (2010) for cabbage.

Per cent contribution of nutrients from soil (Cs) to total uptake

The per cent contribution of nutrients from soil (Cs) to the total uptake was computed from the absolute control plots and it expresses the capacity of the crop to extract nutrients from the soil. In the present study, it was found that the soil has contributed 11.70 per cent of available N, 11.75 per cent of available P and 10.05 percent of available K respectively towards the total N, P and K uptake by bhendi. Among the three nutrients, the per cent contribution from soil was higher for P followed by N and K. With regard to N and K_2O, comparatively lower Cs was recorded which might be due to the preferential nature of bhendi towards the applied N and K_2O than the native N and K. the above findings are in accordance with Muralidharudu *et al.* (2011) [8] for tomato.

Per cent contribution of nutrients from fertilizers (Cf) to total uptake

The contribution from fertilizer nutrients (Cf) of bhendi, the values were 30.20, 25.73 and 77.03 per cent, respectively for N, P_2O_5 and K_2O and followed the order of K_2O > N > P_2O_5. The response yardstick recorded was 24.62 kg kg^{-1}. The estimated Cf clearly revealed the fact that the magnitude of contribution by fertilizer K_2O was 2.99 times higher than P_2O_5 and 2.55 times as that of N. With regard to N and K_2O, comparatively more contribution was recorded from fertilizers than from the soil. The contribution of K from fertilizer was higher and the high value of K could be due to the interaction effect of higher doses of N and P coupled with priming effect of starter K doses in the treated plots which might have caused the release of soil K, resulting in the higher uptake from the native soil sources by the crop (Ray *et al*., 2000 and Deshpande *et al*., 2016) [13, 3]. However, in the case of P_2O_5, the contribution was more from soil than from fertiliser. The results observed in the present study corroborated with the findings of Muralidharudu *et al.* (2007) [9] for tomato.

Contribution of nutrients from FYM for bhendi

The estimated per cent contribution of N, P_2O_5 and K_2O from FYM (Cfym) were 33.78, 11.41 and 41.08 respectively for bhendi which indicated that relatively higher contribution was recorded for K_2O followed by N and P_2O_5 for bhendi. Similar computation of Cfym was reported by Santhi *et al*. (2002) [15] and Saxena *et al*. (2008) [17] for onion.

Fertilizer prescription equations

Soil test based fertilizer prescription equations for desired yield target of bhendi were formulated using the basic paramerters.

NPK alone

$FN = 2.00\ T - 0.39\ SN$

$FP_2O_5 = 1.13\ T - 1.05\ SP$

$FK_2O = 0.93\ T - 0.16\ SK$

NPK with FYM

$FN = 2.00\ T - 0.39\ SN - 1.12\ ON$

$FP_2O_5 = 1.13\ T - 1.05\ SP - 0.98\ OP$

$FK_2O = 0.93\ T - 0.16\ SK - 0.64\ OK$

where, FN, FP_2O_5 and FK_2O are fertilizer N, P_2O_5 and K_2O in kg ha^{-1}, respectively; T is the yield target in q ha^{-1}; SN, SP and SK respectively are alkaline $KMnO_4$-N, Olsen-P and NH_4OAc-K in kg ha^{-1} and ON, OP and OK are the quantities of N, P and K supplied through FYM in kg ha^{-1}.

Fertilizer prescription under IPNS for desired yield target of bhendi

A ready reckoner table was prepared based on these equations for a range of soil test values and for yield targets of 180 q ha^{-1} for bhendi (Table 5.) the data clearly revealed the fact that the fertilizer N, P_2O_5 and K_2O requirements decreased with increase in soil test values. For achieving a yield target of 180 q ha^{-1} of bhendi, for a soil test value of 200 kg ha^{-1} of $KMnO_4$ - N the fertiliser N doses required were 283: 258 and 232 kg ha^{-1} respectively for NPK alone, NPK + FYM @ 6.25 t ha^{-1} and NPK + FYM @ 12.5 t ha^{-1}. The per cent N reduction of 8.8 and 18.0 was observed by addition of FYM @ 6.25 t ha^{-1} and 12.5 t ha^{-1} respectively over NPK alone.

For a soil test value of 20 kg ha^{-1} of Olsen –P, the dose of fertilizer P_2O_5 required for the yield target of 180 q ha^{-1} was 183 kg ha^{-1}, when NPK alone were applied, whereas the dose was 169 kg ha^{-1} for combined addition of NPK + FYM @ 6.25 t ha^{-1} recording 7.6 per cent reduction in fertilizerP_2O_5 over NPK alone. When NPK were applied along with @12.5 t ha^{-1} the dose were 154 kg ha^{-1} with per cent reduction of 15.8 over NPK alone for the soil test value of 20 kg ha^{-1} of Olsen P. Similarly for achieving a yield target of 180 q ha^{-1} of bhendi, for a soil test value of 200 kg ha^{-1} of NH_4OAc-K the fertiliser K doses required were 135: 114 and 92 kg ha^{-1} respectively for NPK alone, NPK + FYM @ 6.25 t ha^{-1} and NPK + FYM @ 12.5 t ha^{-1}. The per cent N reduction of 15.5 and 32.5 was observed by addition of FYM @ 6.25 t ha^{-1} and 12.5 t ha^{-1} respectively over NPK alone.

The experiment results revealed that application of FYM along with soil test based fertilizer recommendation

(200:20:200) would save 25, 15 and 22 kg of fertilizer N, fertilizer P_2O_5, and fertilizer K_2O respectively at 6.25 t ha^{-1} and 51, 29 and 44 kg ha^{-1} at 12.5 t ha^{-1}. The per cent reduction in NPK fertilisers under IPNS also increased with increasing soil fertility levels with reference to NPK and decreased with increase in yield targets. Similar trend of results were also reported by Balamurugan (2009) [1] in wheat, Smitha John *et al*. (2010) [19] in cabbage and Santhi *et al*. (2011) [14] in beetroot.

From above finding, it can be concluded that integrated nutrient application through organic manure and inorganic fertilizer were superior over the sole application of inorganic fertilizer alone in recording both higher yield and nutrient uptake by bhendi. The IPNS improves the soil fertility which helps to achieve the sustained yield in bhendi with less environment pollution. Moreover, STCR based fertilizer recommendation gives idea about yield target can be achieved with good agronomic practices and also STCR based fertilizer recommendation increases the profit by achieving higher yield and reduce the cost of cultivation by fertilizers savings. Finally, the fertilizer prescription equation developed could be used for making fertilizer recommendation for targeted yields of bhendi in Inceptisol of Puducherry.

Table 5: Soil test based fertilizer prescription under IPNS for yield target of 180 q ha^{-1} for bhendi (kg ha^{-1})

Parameter	IPNS				
	NPK alone (kg ha^{-1})	NPK+FYM 6.25 t ha^{-1} (kg ha^{-1})	Per cent reduction over NPK	NPK+ FYM 12.5 t ha^{-1} (kg ha^{-1})	Per cent reduction over NPK
KMnO4-N (kg ha^{-1})					
200	283	258	8.8	232	18.0
220	275	250	9.1	225	18.2
240	267	242	9.4	217	18.7
260	260	234	10.0	209	19.6
280	252	227	9.9	201	20.2
300	244	219	10.3	194	20.5
320	236	211	10.6	186	21.2
Olsen-P (kg ha^{-1})					
10	193	179	7.2	165	14.5
12	191	177	7.3	163	14.6
14	189	175	7.4	160	15.3
16	197	173	7.4	158	15.5
18	185	171	7.5	156	15.6
20	183	169	7.6	154	15.8
22	181	167	7.7	152	16.0
NH_4OAC-K (kg ha^{-1})					
100	151	129	14.5	108	28.4
120	148	126	14.8	105	29.0
140	145	123	15.1	102	29.6
160	142	120	15.9	98	30.9
180	138	117	13.9	95	30.1
200	135	114	15.5	92	32.5
220	132	111	15.9	89	19.8

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