# **Supplementary online material**

## **Table S1**

**Table S1.** Response of wheat grain yield (kg ha-1) to N, P, K and S fertilizer on different soil types in Ethiopia

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nutrient | Rate (kg ha-1) | Cambisols | Luvisols | Nitisols | Vertisols |
| N | 0 | 2212(1410-3013) | 2930(1680-4181) | 2634(1624-3645) | 2702(1954 - 3450) |
|  | 46 | 2888(2086-3689) | 3319(2068-4570) | 3008(1998-4019) | 3189(2441-3937) |
|  | 92 | 2997(2196-3799) | 3483(2232-4733) | 3226(2215 - 4236) | 4098(3350-4846) |
|  | 138 | 3170(2368-3971) | 3582(2331-4833) | 3044(2034 - 4055) | 3538(2790-4287) |
|  | 176 | 2981(2180-3783) | 3557(2307-4808) | 3316(2305 - 4326) | 3820(3072-4568) |
|  | 222 | 2806(2005-3608) | 2603(1352-3854) | 3179(2168 - 4189) | 3948(3200-4696) |
| P | 0 | 2860(2202-3517) | 3176(2015-4338) | 2822(1879 - 3765) | 2774(2116 - 3431) |
|  | 10 | 3357(2699-4014) | 3346(2184-4507) | 2991(2049 - 3934) | 2777(2120 - 3435) |
|  | 20 | 3636(2979-4294) | 3306(2145-4467) | 3251(2308 - 4194) | 2933(2275 - 3590) |
|  | 30 | 3325(2668-3983) | 3267(2106-4428) | 2990(2047 - 3933) | 2931(2274 - 3589) |
|  | 40 | 3601(2943-4258) | 3296(2134-4457) | 3212(2269 - 4155) | 2970(2313 - 3628) |
|  | 50 | 3720(3063-4378) | 2738(1577-3899) | 3369(2426 - 4312) | 3043(2385 - 3700) |
| K | 0 | 3828(3028-4629) | 3516(2097-4935) | 2951(1949 - 3952) | 3111(2254 - 3967) |
|  | 18 | 4065(3264-4865) | 3338(1919 -4757) | 3266(2264 - 4267) | 3616(2759 - 4472) |
|  | 36 | 3866(3097-4635) | 3616(2197-5035) | 3200(2199 - 4202) | 3377(2549 - 4206) |
|  | 54 | 3775(2975-4576) | 3527(2108-4946) | 3057(2055 - 4059) | 3268(2411 - 4124) |
|  | 72 | 3890(3089-4691) | 3345(1926-4763) | 2974(1973 - 3976) | 3709(2853 - 4566) |
|  | 90 | 3804(2722-4886) | 3519(2101-4938) | 3206(2205 - 4208) | 3521(2608 - 4433) |
|  | 108 | 4107(3025-5189) | 3290(1871-4709) | 3171(2154 - 4188) | 3639(2726 - 4551) |
|  | 126 | 3557(2475-4639) | 2579(1160-3998) | 3256(2239 - 4273) | 3493(2580 - 4405) |
| S | 0 | 3327(2674-3981) | 3462(2160-4763) | 2988(2068 - 3908) | 3330(2704 - 3956) |
|  | 10 | 3419(2765-4072) | 3376(2074-4678) | 2901(1981 - 3820) | 3344(2718 - 3970) |
|  | 20 | 3336(2682-3989) | 3540(2238-4841) | 3095(2175 - 4014) | 3294(2668 - 3920) |
|  | 30 | 3369(2715-4022) | 3499(2197-4801) | 3067(2148 - 3987) | 3225(2599 - 3851) |
|  | 40 | 3284(2627-3941) | 3547(2246-4849) | 3141(2221 - 4061) | 3172(2544 - 3800) |
|  | 50 | 3421(2770-4072) | 2825(1523-4126) | 2967(2047 - 3886) | 3252(2628 - 3876) |

*Numbers in parenthesis represent 95% confidence limits; Na represent data not available; Na = Data not available*

## **Table S2**

**Table S2.** Response of wheat grain yield (kg ha-1) to N, P, K and S fertilizer in different agro-ecological zones (AEZ) in Ethiopia

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nutrient | Rate (kg ha-1) | H3 | M3 | SH3 | SM3 | SM4 |
| N | 0 | 2865(1836- 3895) | 1425(278- 2572) | 2977(2225- 3729) | 1789(938- 2639) | 2574(1674- 3474) |
|  | 46 | 3220(2191- 4249) | 2703(1556- 3849) | 3400(2649- 4152) | 2141(1291- 2991) | 3338(2438- 4237) |
|  | 92 | 3458(2429- 4487) | 3145(1999- 4292) | 3987(3235- 4739) | 2549(1699- 3400) | 3757(2857- 4657) |
|  | 138 | 3252(2223- 4281) | 3014(1867- 4161) | 3638(2886- 4389) | 2475(1625- 3325) | 3733(2833- 4633) |
|  | 176 | 3562(2532- 4591) | 2923(1777- 4070) | 3496(2744- 4248) | 2712(1862- 3562) | 4046(3146- 4946) |
|  | 222 | 3420(2391- 4449) | 2978(1832- 4125) | 2890(2138- 3641) | 2998(2148- 3848) | 3978(3078- 4878) |
| P | 0 | 3285(2577- 3993) | 2817(1952- 3682) | 2867(2243- 3491) | 2123(1387- 2858) | 3261(2486-4037) |
|  | 10 | 3477(2769- 4184) | 2822(1957- 3687) | 3131(2507- 3755) | 2561(1826- 3296) | 3406(2631- 4182) |
|  | 20 | 3795(3087- 4503) | 3373(2508- 4238) | 3210(2586- 3834) | 2724(1988- 3459) | 3415(2639- 4190) |
|  | 30 | 3466(2765- 4166) | 2432(1567- 3296) | 3099(2471- 3726) | 2659(1924- 3394) | 3467(2692- 4242) |
|  | 40 | 3731(3024- 4439) | 3320(2456- 4185) | 3165(2541- 3788) | 2738(2003- 3473) | 3526(275 - 4301) |
|  | 50 | 3869(3162- 4577) | 3626(2761- 4491) | 2906(2282- 3530) | 2862(2127- 3598) | 3639(2864- 4415) |
| K | 0 | 3260(2332- 4187) | 1929(858- 2999) | 3524(2589- 4330) | 2984(1850- 4118) | 4518(2846- 6189) |
|  | 18 | 3571(2644- 4498) | 2906(1836- 3976) | 3561(2747- 4341) | 3263(2129- 4397) | 4881(3209- 6552) |
|  | 36 | 3541(2618- 4463) | 2350(1410- 3289) | 3544(2803- 4433) | 3165(2031- 4299) | 4616(3025- 6207) |
|  | 54 | 3340(2413- 4268) | 1891(821 - 2961) | 3618(2729- 4359) | 2864(1730- 3998) | 4906(3234- 6577) |
|  | 72 | 3196(2269- 4123) | 2252(1182- 3322) | 3544(2749- 4490) | 3343(2209- 4477) | 5282(3610- 6953) |
|  | 90 | 3483(2549- 4418) | Na | 3620(2108- 3738) | 3169(2035- 4303) | Na |
|  | 108 | 3421(2467- 4375) | Na | 3459(2007- 3749) | 3340(2206- 4474) | Na |
|  | 126 | 3509(2555- 4463) | Na | 2878(2746- 4376) | 3079(1945- 4213) | Na |
| S | 0 | 3371(2457- 4284) | 2554(1589- 3519) | 3457(2659- 4255) | 2810(2032- 3589) | 3371(2541- 4202) |
|  | 10 | 3232(2318- 4145) | 3074(2109- 4039) | 3426(2628- 4224) | 2838(2060- 3617) | 3429(2599- 4260) |
|  | 20 | 3442(2528- 4355) | 2898(1933- 3862) | 3476(2677- 4274) | 2757(1978- 3535) | 3404(2573- 4234) |
|  | 30 | 3420(2507- 4334) | 2806(1842- 3771) | 3401(2603- 4199) | 2703(1925- 3481) | 3379(2549- 4210) |
|  | 40 | 3418(2505- 4332) | 2564(1600- 3529) | 3569(2771- 4367) | 2650(1864- 3436) | 3311(2480- 4141) |
|  | 50 | 3335(2421- 4248) | 2853(1888- 3817) | 3190(2392- 3988) | 2701(1928- 3473) | 3450(2620- 4281) |

*Numbers in parenthesis represent 95% confidence limits; Na represent data not available; Na = Data not available*

## **Table S3**

**Table S3.** Changes in yield (%) relative to the control due to N, P, K and S fertilizer on different soil types and agro-ecological zones (AEZ) in Ethiopia

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Soil type |  |  |  |  | AEZ |  |  |  |  |
| Nutrient | Rate | Cambisols | Luvisols | Nitisols | Vertisols |  | H3 | M3 | SH3 | SM3 | SM4 |
| N | 46 | 30.6 | 13.3 | 14.2 | 18.0 |  | 12.4 | 89.7 | 14.2 | 19.7 | 29.7 |
|  | 92 | 35.5 | 18.9 | 22.5 | 51.7 |  | 20.7 | 120.7 | 33.9 | 42.5 | 46.0 |
|  | 138 | 43.3 | 22.3 | 15.6 | 30.9 |  | 13.5 | 111.5 | 22.2 | 38.3 | 45.0 |
|  | 176 | 34.8 | 21.4 | 25.9 | 41.4 |  | 24.3 | 105.1 | 17.4 | 51.6 | 57.2 |
|  | 222 | 26.9 | -11.2 | 20.7 | 46.1 |  | 19.4 | 109.0 | -2.9 | 67.6 | 54.5 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| P | 10 | 17.4 | 5.4 | 6.0 | 0.1 |  | 5.8 | 0.2 | 9.2 | 20.6 | 4.4 |
|  | 20 | 27.1 | 4.1 | 15.2 | 5.7 |  | 15.5 | 19.7 | 12.0 | 28.3 | 4.7 |
|  | 30 | 16.3 | 2.9 | 6.0 | 5.7 |  | 5.5 | -13.7 | 8.1 | 25.2 | 6.3 |
|  | 40 | 25.9 | 3.8 | 13.8 | 7.1 |  | 13.6 | 17.9 | 10.4 | 29.0 | 8.1 |
|  | 50 | 30.1 | -13.8 | 19.4 | 9.7 |  | 17.8 | 28.7 | 1.4 | 34.8 | 11.6 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| K | 15 | 6.2 | -5.1 | 10.7 | 16.2 |  | 9.5 | 50.6 | 1.0 | 9.3 | 8.0 |
|  | 30 | 1.0 | 2.8 | 8.4 | 8.6 |  | 8.6 | 21.8 | 0.6 | 6.1 | 2.2 |
|  | 45 | -1.4 | 0.3 | 3.6 | 5.0 |  | 2.5 | -2.0 | 2.7 | -4.0 | 8.6 |
|  | 60 | 1.6 | -4.9 | 0.8 | 19.2 |  | -2.0 | 16.7 | 0.6 | 12.0 | 16.9 |
|  | 75 | -0.6 | 0.1 | 8.6 | 13.2 |  | 6.8 |  | 2.7 | 6.2 |  |
|  | 90 | 7.3 | -6.4 | 7.5 | 17.0 |  | 4.9 |  | -1.8 | 11.9 |  |
|  | 105 | -7.1 | -26.6 | 10.3 | 12.3 |  | 7.6 |  | -18.3 | 3.2 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| S | 10 | 2.8 | -2.5 | -2.9 | 0.4 |  | -4.1 | 20.4 | -0.9 | 1.0 | 1.7 |
|  | 20 | 0.3 | 2.3 | 3.6 | -1.1 |  | 2.1 | 13.5 | 0.5 | -1.9 | 1.0 |
|  | 30 | 1.3 | 1.1 | 2.6 | -3.2 |  | 1.5 | 9.9 | -1.6 | -3.8 | 0.2 |
|  | 40 | -1.3 | 2.5 | 5.1 | -4.7 |  | 1.4 | 0.4 | 3.2 | -5.7 | -1.8 |
|  | 50 | 2.8 | -18.4 | -0.7 | -2.3 |  | -1.1 | 11.7 | -7.7 | -3.9 | 2.3 |

## **Figure S1**

|  |  |
| --- | --- |
|  |  |
|  |  |

**Figure S1**. Variation in yield response of wheat to K and S rates on different soils